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ABSTRACT

The purpose of this project was to develop and present a set of recommendations for supplements to the existing Uniform Federal Accessibility Standards (UFAS) that would apply to environments used by children with physical disabilities. The work was subdivided into six phases: (1) review of selected codes, standards and guidelines; (2) review of ergonomic studies and new products/technologies; (3) review of recent evaluation literature; (4) post-occupancy evaluations of environments serving children with disabilities; (5) development of draft recommendations for standards based on previous project; and (6) preparation of the final technical report presenting results of the previous five phases. Specific technical recommendations provide guidelines for parking, loading ramps, stairs, elevators, doors, lavatories, storage, signage, seating, telephones, food service facilities, and many other physical aspects of environments for use by children with disabilities. Specific site reports are also provided, detailing facilities and accommodations at environments chosen for post-occupancy evaluations. Appendices provide summaries of findings and references, an annotated bibliography, and details of the consensus process and the advisory committee. (Contains 26 references.) (PB)

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Recommendations for Accessibility Standards for Children's Environments

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United States Architectural and Transportation Barriers Compliance Board
1331 F Street, NW Suite 1000
Washington, D.C. 20004-1111

Accessibility Standards for Children's Environments

Task Five

Technical Report

Recommendations for Accessibility Standards for Children's Environments

Prepared for:

The Architectural and Transportation Barriers Compliance Board
Washington, D.C.
***Contract Number:* QA90003001**

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EXECUTIVE SUMMARY

Until now, in the United States, the only Federal accessibility standards applicable to environments used by children have been the existing UFAS (Uniform Federal Accessibility Standards, 1988).

In childcare centers, pre-kindergarten and elementary schools across the country, to comply with the law, accessibility standards have had to be applied that were developed for an adult population. These have met the needs of adult users with disabilities working in or visiting children's facilities, but not necessarily the access needs of the majority population.

In a first major step to address the lack of access standards for children's environments, in 1986 the ATBCB issued its own *Recommendations for Accessibility to Serve Physically Handicapped Children in Elementary Schools.*

As a further step, in late 1989, the ATBCB contracted with the Center for Accessible Housing (CAH) at North Carolina State University's School of Design to develop a full set of recommendations for access standards for environments used by children of all ages -- not just those of elementary school age and not limited to physical disability. Beyond schools and special education facilities, the scope was expanded to include all environments where children with disabilities are likely to be part of the user population.

The purpose of the project was to develop and present a set of recommendations for supplements to the existing UFAS that would apply to environments used by children. The work was subdivided into six phases:

1. Review selected codes, standards and guidelines.

2. Review ergonomic studies and new products and technologies.

3. Review recent evaluation literature.

4. Conduct post-occupancy evaluations (POEs) of environments serving children with disabilities.

5. Develop draft recommendations for standards based on 1-4 above and facilitate a review of the draft recommendations by the project Advisory Committee at a face-to-face consensus meeting.

6. Prepare the final technical report presenting the final recommendations and background studies (1-4 above).

A first step in developing the research strategy was to carefully review the existing UFAS to select only those provisions judged to be relevant to environments used by children, under main headings as follows (with UFAS numerical references):

2. General
4.2 Space Allowances and Reach Ranges
4.3 Accessible Route

4.4 Protruding Objects
4.5 Ground and Floor Surfaces
4.6 Parking and Passenger Loading Zones
4.8 Ramps
4.9 Stairs
4.10 Elevators
4.13 Doors
4.15 Drinking Fountains and Water Coolers
4.16 Water Closets
4.17 Toilet Stalls
4.18 Urinals
4.19 Lavatories and Mirrors
4.21 Shower Stalls
4.22 Toilet Rooms
4.23 Bathrooms, Bathing Facilities and Shower Rooms
4.24 Sinks
4.25 Storage
4.27 Controls and Operating Mechanisms
4.30 Signage
4.31 Telephones
4.32 Seating, Tables, and Work Surfaces
5. Restaurants and Cafeterias
8. Libraries

This list of selected UFAS items was then used as the basis for a standard set of comparative tables on which the results of each of the principal research phases of the project could be recorded.

Existing Standards, Guidelines and Codes

The first research phase covered the review of the existing standards, guidelines and building codes that pertained to accessibility standards for children with disabilities (Chapter 1). The purpose at this stage of the work was to identify similarities and differences in the specifications and highlight gaps to be addressed in later phases of the project.

Of the many sources used, two provided most of the relevant information: *Building Standards for Educational Facilities for Handicapped Children*, issued by the Florida Department of Education in 1988, and the ATBCB's own *Recommendations for Accessibility to Serve Physically Handicapped Children in Elementary Schools.* Also reviewed were the UFAS; three model codes (the Standard Building Code, the Building Officials and Code Administrators International Code and the Uniform Building Code); and selected code and guideline documents from several states and state departments of education (North Carolina, California, Illinois, Michigan and Texas).

The findings from the first phase of work were based on the results of reviews of selected code-related or guideline documents and from telephone conversations with state code officials and officials from several state departments of education. States were contacted who had access provisions for children's environments that were unique home-grown efforts or that were based on the UFAS or that were based on one of the model codes. ANSI-based states were not contacted since the ANSI Standard A117.1 (1980 or 1986) does not contain provisions specific to children's environments. States with provisions based on the model codes were later dropped as the model codes also do not contain provisions for children. Besides Florida, North Carolina was the only other state department of education that acknowledged the needs of children with disabilities in terms of special building code provisions.

Ergonomic Research

The second phase of work included a review of ergonomic research literature related to the physical limitations of children with disabilities that affect their ability to access the physical features of their everyday environment (Chapter 2). In this regard only two items of relevant research were identified. One was the substantial 1988 study by Australians Bails and Seeger: *Ergonomic Design for Physically Disabled Children (parts I and II).* In this work, the physical abilities of able-bodied and disabled children aged 3 - 18 years were assessed in a variety of task-oriented settings. The second ergonomic study was by Steinfeld and Czaja (1980).

Products and Technologies

The second phase of work also covered a review of literature related to new products and technologies (Chapter 2). With new technology and assistive devices playing an important role in increasing the independence of children with disabilities, it is clear that the new design standards for children should be compatible with or take advantage of any new technology.

The research team reviewed information on different types of assistive devices that were available. The types of products included wheelchairs and seating devices that have adjustable height seats, wheelchairs that permit the user to stand or to be lowered to floor level, electronic tablets that use synthesized speech to aid a child with no speech, visual alert and warning devices, telecommunications devices for the deaf (TDD's) and environmental controls. The review was conducted to determine if any of the devices had characteristics that should be addressed in the revised design standards. Major findings were as follows.

Improvement of Independence. New products and technologies significantly improve or offer the potential to improve the level of independence and quality of life for children with disabilities. Wheelchairs are available that can lower a child from a standard seat height to a few inches above the floor so the child can get onto the floor to play, that can support a child in a standing position, and permit a child to cover large amounts of irregular terrain easily.

Augmentative communication devices such as touch tablets permit children with severe speech disabilities to communicate through synthesized speech.

Child/Adult differences in use. When the use of the products was compared to their use by adults, it was difficult to find unusual or significant differences that should be addressed in the revised standards. Children use the products in similar ways to adults with only few exceptions. One is the ability to maneuver a wheelchair in a precise fashion and this is addressed in the revised standard.

Availability. The lack of widespread availability of some of the new products was a concern to the research team. Design standards have not typically specified conditions that cannot be addressed by commonly available products. Many of the new products are not widely available at this time.

Lack of research. It was also difficult to find research or field data on the use of the new products and technologies. None of the research studies that were reviewed covered use of these devices in laboratory settings and the POE data only served to identify a variety of devices that were in use at the POE sites.

The standards that have been developed by this project continue the practice used by the UFAS and the ADAAG of not including specifications for uncommon or extremely expensive products or devices. Wide ranges are provided for seat height (of toilets in particular) because a limited range did not accommodate children of different ages and abilities. Specifications were not included for other new types of products such as speech devices because the use of these devices was not uniquely different to their use by adults. Furthermore, much of the new technology is not permanently installed in buildings and traditionally the UFAS and the ADAAG have covered elements and features that are permanently installed.

The development of new products and technologies for children with disabilities (and for adults as well) is likely to expand significantly due to the the Americans with Disabilities Act and the growing acceptance of new technology by the consumer. It is recommended that the ATBCB should periodically review the design standards for children and make additions and changes as needed.

The ATBCB should also facilitate a study or studies in conjunction with research sponsored by other government agencies such as the National Institute on Disability and Rehabilitation Research (NIDRR) on the use of selected new technology such as power wheelchairs for children. Data from such studies would be useful during future revisions of the design standards.

Design-related Research

In the third phase of work, a broader literature review of sources from 1975 to the present was conducted (Chapter 3). This produced one hundred and seventy-six references directly relevant to the design of environments used by children with disabilities. Although very few of the studies were post-occupancy evaluation studies, all contained design-relevant information that could be useful in informing the development of standards.

Twenty-three of these references were felt to be comprehensive and significant enough to be included in an annotated bibliography.

Six of the works included actual design specifications. These were therefore selected for systematic analysis in relation to the UFAS provisions under investigation. The works included two reports from state education agencies (Maryland and New York) and four research-based design guides (People's Housing, 1985; G. Moore et al, 1979b.; R. Moore, el al, 1987; and I. Nellist, 1970).

Post-occupancy Evaluations

The fourth phase of work included post-occupancy evaluations (POEs) of nine educational and recreational facilities used by children (Chapter 4), as follows:

Boston Children's Museum, Boston, MA
Preschool Handicapped Classroom Facility, Gainsville, FL
Georgia Academy for the Blind, Macon, GA
Massachusetts Hospital School, Canton, MA
Baylies Beginning Center, Massachusetts Hospital School, Canton, MA
E. Rivers Elementary School, Atlanta, GA
United Cerebral Palsy Developmental Center, Spring Lake, NC
East Wake Middle and Vance Elementary Schools, NC
West Pennsylvania School for Blind Children, Pittsburgh, PA

The sites covered a range of physical conditions ranging from new construction to retrofitted facilities. Five of the sites contained buildings that were build to be accessible. The primary purpose of the POEs was to observe and evaluate the suitability of accessible features, built to different technical specifications, for children of different ages whose disabilities differed in type and severity.

In addition, information was obtained through direct observation and focus group discussions with children and staff about how well existing features worked for children and adults such as teachers and house parents, whose jobs involved interaction with children at each site. The information obtained through the POEs provided direct evidence concerning the extent to which the accessible features covered by the UFAS provisions worked (or did not work).

One- or two-day visits were made by members of the research team to conduct the post-occupancy evaluations of the accessible features covered by the selected UFAS provisions. Physical measures of each accessible feature were recorded and compiled on the standard comparative "matrix tables" so that comparisons could be made across sites as well as with the findings of the earlier phases of research.

Physical measures of the accessible features were gathered early on during the site visit. Following this, a set of observational studies were made of accessible features using video as the recording medium. In cases of frequently used accessible features, records of natural behavior were made. In cases of low frequency use, observations of simulated behavior of volunteer children were made, who at the same time were interviewed regarding the ease of use of the accessible feature. Observational data was coded on a five-point scale from "unable to use" to "no problem in use."

Finally, focus groups were held with children and staff to discuss the findings of the observational studies and other issues related to the accessible features of the site.

Two types of factors affected the usability/accessibility of accessible features: characteristics of the children and characteristics of the situation. Age and type and severity of disability were the most important characteristics of children. They affected specific factors such as:

- fine motor ability (e.g., to operate controls);
- upper body strength (e.g., to open doors);
- extent of reach (e.g., to use wall-mounted objects, grab bars, etc.);
- stature (e.g., to transfer);
- stamina (e.g., to climb stairs);
- balance (e.g., to maintain an upright position on a toilet);
- skill level in negotiating an environment (e.g., in maneuvering a wheelchair precisely).

Important characteristics of the situation included:

- the number of disabled individuals using a facility;
- the policies and practices of the institution regarding staff intervention in helping children achieve independence;
- dimensions and other physical characteristics of accessible features.

Based on the extensive documented findings from the POEs, the following main conclusions were made related to UFAS provisions:

Accessible Route: Wider accessible routes work well in children's environments for several reasons. They are necessary to avoid congestion and permit two-way traffic in settings where one might expect a number of children in wheelchairs. In addition, age-, and to some extent, disability-related differences between children and adults' skill levels require that facilities for children be provided with wider accessible routes.

Children's levels of stamina also tend to influence the distances that they can traverse. This has important implications for the length of accessible routes at multi-building sites such as schools. It also should influence the number and location of accessible features such as elevators and ramps along the route. For example, one elevator at one end of a school may be insufficient if a student in a wheelchair has classes on different floors at the opposite end. This situation would, in effect, unnecessarily increase the length of the route that the student must traverse.

Ramps: Many children, particularly those using manual wheelchairs who have limited strength and stamina, experienced difficulties ascending ramps, even those that were within the UFAS specifications. As a result, at several sites, children were pushed up ramps by parents or staff. Moreover, staff at one school maintained that a slope of 1:16 was required. Clearly, 1:12 is too steep as a maximum allowable slope for ramps that will be used by children

Although 36" is sufficient as a minimum clear width of ramps for a single wheelchair to maneuver safely, the minimum width should be considerably greater in facilities where a number of children in wheelchairs use the ramp at the same time. This enables two-way traffic and can help to avoid congestion and accidents.

Edge protection was only observed at one site where it exceeded the UFAS minimum by 6". Children only had problems with the lack of edge protection at one site where their wheelchairs dropped off the side of the ramp. It is evident that edge protection is necessary, but there is no data to indicate that the UFAS minimum is inappropriate.

Stairs: Although no problems with the use of stairs (including tread width, riser height, and handrails) were observed, stairs, nonetheless, can pose a serious safety hazard for visually impaired and nonambulatory children whose skill levels in navigating the environment are less than those of young adults. Detectable warnings and/or barriers (such as the bollards found at one site) are needed at the top of stairs to prevent accidents.

Elevators: Operating controls are too high for many children as a function of body stature and reach. In addition, children with arm and hand impairments have even more difficulty in reaching controls. Call and car control buttons at all sites were higher than the maximum height specified by the 1986 ATBCB Recommendations. This suggests that the UFAS maximums of 34" and 36" for call and car control buttons, respectively are probably better suited for children with disabilities than the heights found in the sites evaluated. However, there is no data from the site visits to support the specification of these heights.

Finally, call control buttons are too small for many disabled children who have limited hand and finger control. In several instances, children had difficulty with using call control buttons that were 1" in diameter. This indicates that the minimum size of .75" specified in UFAS may be too small for some disabled children to use.

Doors: One of the most pervasive problems for children of different ages and with different types and severity of disabilities is pulling/pushing and holding doors open. Virtually all children, not just those using wheelchairs or with gait and balance disorders experienced difficulty in using doors. It is likely that the widespread existence of this problem is related to the influence of fire codes on doors specified for settings such as schools. It is clear, that doors that are easier to operate but do not violate other health and safety considerations are needed in children's environments.

Hardware on all doors exceeded the 36" maximum specified by the 1986 ATBCB Recommendations. Although children at one site were observed having difficulty reaching hardware that was located at 45" AFF, staff at another reported that the hardware in their building, which only exceeded the ATBCB Recommendations by 3-5", worked well for both children and adults. This suggests that a maximum height somewhere between 36" (ATBCB Recommendations) and 48" (UFAS) may be appropriate.

Two alternatives to hinged doors with automatic closers were examined in this project: magnetic door closers at Wake County Schools and automatic opening doors at West Pennsylvania School for Blind Children and the Gainesville Handicapped Preschool. In effect, doors that are closed need to be easier to open, or if they are left open, they need to be easier to close.

Drop-Off and Loading Zones: Loading zones compatible with the type and volume of vehicular traffic common at settings such as schools and museums are needed to avoid congestion and reduce waiting time. Further, access aisles should be provided for the number and types of vehicles that the loading zone is designed to accommodate. Covered walkways between the loading zone and the accessible entry are desirable. Canopies need to be low enough to offer protection from blowing rain and high enough to permit access by school buses and emergency vehicles.

Classrooms and Instructional Areas: Although the 1986 ATBCB Recommendations set a maximum height of 30" for work surfaces, only two sites had heights greater than 25.5". Height, in and of itself, however, was not as important as the provision of work surfaces at a number of different heights. Adjustable work surface heights, and/or work surfaces of a variety of heights seemed to work best in any given situation, accommodating children of different stature, working in a standing, leaning or sitting position (using wheelchairs as well as table chairs).

In settings where there are a number of children using wheelchairs, the location and number of legs on tables pose problems. Although pedestal-type tables would help to avoid problems experienced by children in wheelchairs, this style of table may not be stable enough for children who need to lean on the table for support.

Storage: The 40" high storage investigated at one site seemed to work well for ambulatory preschoolers. However, 43" was too high for older nonambulatory children at another site. This indicates that shelves and hooks could possibly be higher than 36", although how much higher is not clear. Certainly 43" is too high. Furthermore, the most appropriate height of storage is influenced by body stature, body position, and forward and upward reaching capabilities of the child. It is unlikely that fixed storage heights will work for a cross section of children. Adjustable shelving of different depths is a viable option to this problem.

Toilets, Urinals and Toilet Stalls: Age and independence in toileting influence the suitability of different toilet seat heights. Among young children the critical issue related to toilet height is to insure that the toilet is low enough for them to get their feet on the ground, which provides a sense of stability and improves body functioning. As most young children using wheelchairs were placed on toilets, toilet heights compatible with transferring was less of an issue for this age group. For this group of children heights of 12" at one site and 11" at another seemed to work better than the 15.5" height at a third site. All these heights are considerably lower than the 15"-17" specified by the 1986 ATBCB Recommendations.

In contrast, among older children who transfer with or without assistance from a wheelchair, the critical issue is the height of the toilet in relation to the height of the wheelchair.

The use of toilet side grab bars by children with age- or disability-related reach limitations is related to their distance from the toilet, more so than their height. Different grab bar configurations work well for children of different stature with different types and severity of orthopaedic disabilities.

The 36" wide toilet stall is not suitable for many children who could not perform a frontal transfer. A wider stall is more suitable as it provides sufficient room for side transfers, transfer to a commode chair, or assisted transfers. In addition, this type of stall provides adequate space for children with limited reach to approach the controls from the side and operate them.

Lavatories, Bathtubs, and Showers: The suitability of sink heights are related to age and type of disability. Very young ambulatory children need sinks that are lower than those needed by nonambulatory children of a similar age and stature. This is evidenced by the difficulty that ambulatory children at one preschool site had with using the 30" high lavatory. In contrast, nonambulatory children could not get their wheelchairs under sinks that were lower. This suggests that the minimum height of 30" specified in the 1986 ATBCB Recommendations is only adequate for nonambulatory preschool children.

In addition, children with reaching problems and those who were small in stature experienced difficulty operating controls that are located at the back of sinks and lavatories. This problem was exacerbated for children who were also wheelchair users. Faucets and controls at the front of the sink are more accessible to more children.

Finally, the location of controls on lavatories, tubs and showers is dependent on decisions related to the amount of independence children should have. In some cases (e.g., when a child needs attendant care), it may be more appropriate to put controls out of the reach of children in order to ensure their safety.

Advisory Committee Consensus

The findings and conclusions of the first four phases of work were used to generate a set of draft recommendations that would supplement the existing UFAS. These were transmitted to the project Advisory Committee for review, together with backup information from phases 1-4.

At a two-day consensus meeting of the Advisory Committee, all draft recommendations were reviewed in small working groups and final consensus decisions were made in plenary sessions of the whole committee.

Consensus was reached on all items except for "high forward reach over an obstruction" and "high side reach over an obstruction" (UFAS 4.2.5 and UFAS 4.2.6). Both these provisions were reserved because insufficient data was available to make an informed decision.

Recommendations

The final version of the recommended supplements to UFAS for environments used by children were made for the following UFAS provisions (Chapter 5):

2. General

3.5 Definitions

4.2 Space Allowances and Reach Ranges
    4.2.1 Wheelchair Passage Width
    4.2.2 Width of Wheelchair Passing
    4.2.5 Forward Reach
    4.2.6 Side Reach

4.3 Accessible Route
    4.3.3 Width
    4.3.4 Passing Space
    4.3.6 Surface Textures

4.4 Protruding Objects
    4.4.1 General
    4.4.2 Head Room

4.5 Ground and Floor Surfaces
    4.5.1 General
    4.5.3 Carpet
    4.5.4 Gratings

4.6 Parking and Passenger Loading Zones
    4.6.5 Passenger Loading Zone
    4.6.6 Vertical Clearance
    4.6.7 Cover (additional requirement)

4.7 Curb Ramps
    4.7.1 Location

4.8 Ramps
    4.8.2 Slope and Rise
    4.8.3 Clear Width
    4.8.4 Landings
    4.8.5 Handrails

- 4.9 Stairs
  - 4.9.4 Handrails (stair)
  - 4.9.5 Detectable Warnings at Stairs

- 4.10 Elevators
  - 4.10.3 Hall Call Buttons
  - 4.10.5 Raised Characters on Hoistway
  - 4.10.12 Car Controls
  - 4.10.14 Emergency Communications

- 4.13 Doors
  - 4.13.8 Thresholds at Doorways
  - 4.13.9 Door Hardware
  - 4.13.11 Door Opening Force

- 4.15 Drinking Fountains and Water Coolers
  - 4.15.2 Spout Height
  - 4.15.4 Fountain Controls
  - 4.15.5 Clearances

- 4.16 Water Closets
  - 4.16.3 Height
  - 4.16.4 Grab Bars
  - 4.16.5 Flush Controls
  - 4.16.6 Dispensers

- 4.17 Toilet Stalls
  - 4.17.3 Size and Arrangement
  - 4.17.4 Toe Clearance
  - 4.17.6 Grab Bars

- 4.18 Urinals
  - 4.18.2 Height
  - 4.18.4 Flush Controls

- 4.19 Lavatories and Mirrors
  - 4.19.2 Height and Clearance
  - 4.19.3 Lavatory Clear Floor Space
  - 4.19.5 Lavatory Faucets
  - 4.19.6 Mirrors

- 4.21 Shower Stalls
  - 4.21.3 Seat
  - 4.21.5 Controls

- 4.24 Sinks
  - 4.24.2 Height
  - 4.24.3 Knee Clearance
  - 4.24.5 Clear floor space
  - 4.24.7 Faucets

- 4.25 Storage
  - 4.25.3 Height

4.27 Controls and Operating Mechanisms
    4.27.3 Height
    4.27.4 Control Operation

4.30 Signage
    4.30.1 General
    4.30.6 Mounting Height
    4.30.7 Lighting

4.31 Telephones
    4.31.3 Mounting Height

4.32 Seating, Tables, and Work Surfaces
    4.32.2 Seating
    4.32.3 Knee Clearances
    4.32.4 Height of Work Surfaces

5. Restaurants and Cafeterias
5.1 General
5.2 Food Service Lines
5.3 Tableware Areas
5.4 Vending Machines

8. Libraries
8.3 Check-Out Areas
8.4 Card Catalogs
8.5 Stacks

In addition to the foregoing, two further recommendations were made for accessibility issues not covered by UFAS. The most important highlighted the issue that in many schools the accessible route often does not extend beyond the classroom building to connect to specialized spaces such as gymnasia, art rooms, computer laboratories, band and choral practice areas, etc., and very seldom extends to playgrounds and outdoor sports areas.

A second recommendation not covered by UFAS related to the height and clearance of lockers.

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Review of ergonomic studies of children's environments, products and technologies

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CHAPTER 5

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CHAPTER 1

Review of selected codes, standards and guidelines for accessibility for environments used by children with disabilities.

PREFACE

Chapter one reports on a review of existing design standards, guidelines and building codes that pertain to accessibility for children with disabilities. Its major purpose is to document what is specified for accessibility for children with disabilities, identify differences and similarities that exist in the specifications, and draw attention to significant gaps that need to be addressed by the findings of other project activities.

Many sources were used for this report but two provided much of the information used; Florida's guidelines, *Building Standards for Educational Facilities for Handicapped Children,* and the ATBCB guidelines, *Recommendations for Accessibility to Serve Physically Handicapped Children in Elementary Schools.* These two documents had the most complete references to accessibility provisions for children. Other materials that were reviewed for this report included the Uniform Federal Accessibility Standard (UFAS), the three model codes; the Standard Building Code, the Building Officials and Code Administrators International code and Uniform Building Code, the accessibility provisions of selected state building codes and guidelines from several state departments of education.

Two different approaches to specification of accessibility features for children with disabilities were found. One approach, which is the most common, is to identify a limited number of specifications that apply to children but that differ.from the provisions of the accessibility code or standard and only list those items. The other approach is to present a complete set of standards which can stand alone without reference to other documents. Only the Florida standard provides this complete set of specifications for school facilities for children with disabilities. All other documents were provided as supplements or replacements for a state accessibility code. This approach was also taken by the ATBCB when *Recommendations for Accessibility to Serve Physically Handicapped Children in Elementary Schools.* was released in 1986. (This report is written as a supplement to the UFAS. It contains specifications for children with disabilities. Specifications in this report are intended to supplement identical adult specifications in the UFAS).

Some codes did not have specific requirements but did recognize the need for different specifications and some flexibility. For example, New Jersey has no specific requirements for children with disabilities but provides for state accessibility requirements to be changed on a case by case basis. Michigan specifies "Handrails, water closets, lavatories and accessories for small children, such as schoolchildren, shall meet the requirements for their use" and has a set of suggestions provided by the Barrier Free Design Division and the Plumbing division that provides some guidance. These are included in this report under MI Code.

To accommodate the two different approaches that were found, this report is organized around items that are contained in both UFAS and the Florida standard. Initially UFAS and particularly the ATBCB guidelines were to be the basis for our comparison. Since Florida was so broad in its coverage, the scope was expanded to add the major topics from that study.

Information is presented using a consistent format that first presents a table that summarizes the qualitative aspects of a set of features (e.g. telephones) then comments on the data. A background section follows which presents the specifications in qualitative and quantitative terms for that topic from the various standards, guidelines and codes. Blank spaces in the tables in each column except for UFAS indicate no specification for that topic that is unique to children. A blank does not necessarily mean that the state code or guideline does not have a provision for that item, most have adult provisions that apply in the absence of a special provision for children.

Process

The findings presented in this report were collected from reviews of selected materials and from telephone conversations with state code officials and with officials from several state departments of education. States were selected based on the knowledge of the research team, referrals provided by members of the advisory committee and from references cited in the Digest of State Requirements for Handicapped Accessibility, prepared for the ATBCB by Applied Concepts Corporation in 1989. States were selected from that study based on having codes that were not based on the ANSI Standard A117.1 (1980 or 1986). ANSI based states were not generally used because ANSI does not have any provisions that are specific to children with disabilities. States that were contacted had provisions that were unique, were based on UFAS or that were based on one of the model codes. After the model codes were reviewed and found to have no provisions for accessibility for children, the research team focused on those states with unique codes. Several departments of education were contacted to see if an activity similar to the Florida study (Building Standards for Educational Facilities for Handicapped Children) had been done. Only North Carolina acknowledged any special provisions for children with disabilities. However, it is possible that other state departments of education may have special provisions for children with disabilities that our limited contacts did not identify.

Terminology

Several terms are used in this report that may not be widely understood.

AFF	means above finished floor
CL	refers to center line of an object
Min	refers to the minimum allowable
Max	refers to the maximum allowable
1:12	refers to a ratio where 1 refers to vertical distance and 12 refers to horizontal distance

Findings

General

ATBCB Children's Recommendations for Elementary Schools (1986) Reference UFAS Section 2. General Provisions for Children.
The recommendations are presented as additions to the UFAS and are to be used in conjunction with the referenced UFAS provisions.

ATBCB Children's Recommendations for Elementary Schools (1986) Reference UFAS Section 3.5 Definitions.
All terms listed in UFAS 3.5 are applicable, with the following addition: Elementary School. A school which serves grades one through six.

Accessible Route

Summary

Table 1 (following page) summarizes the quantitative requirements for various aspects of accessible routes (for children) as specified by the eight sources plus the UFAS.

Table 1: Accessible Route

Table 1
Accessible Route

	UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.3.3 Width	36" - 48"		44" - 102"	60" - 144"						
4.3.4 Passing Space	60" every 200' max		60" every 100' max							
4.2.1 Wheelchair Passage	36" min (32" at point)									
4.2.3 Wheelchair Turning Space	60" diameter 60" T turn									
4.2.4.1 Clear Floor Space	30" X 48"									Forward or parallel approach
4.2.4.2 Alcoves	30" X 48" 36" X 48"									Forward approach Forward approach > 24" space
4.2.5 Forward Reach AFF AFF	48" max 15" max									> 24" deep space
4.2.6 Side Reach AFF AFF	54" max 9" max									
4.3.8 Changes in Level	max 1/2"		max 1/2"							Greater than 1/2" is ramp
Vertical	≤1/4"		≤1/4"							
1:2 Bevel	1/4" - 1/2"		1/4" - 1/2"							1:2 slope is max
4.5.3 Carpet	1/2" pile max		1/4" pile max							Loop pile only in Florida
4.5.4 Gratings	1/2" wide max		1/4" wide max							Width of space in one direction

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Comments related to Table 1

Only Florida contains specific requirements for accessible routes that differ from UFAS. The state codes do not have any specific requirements for accessible routes that are identified as being different from the accessible requirements for adults. The guidelines from the North Carolina Department of Education for schools specifies a minimum width of a corridor or pathway that is different from the requirement specified by Florida. Florida requires that a passing space be provided every 100ft. The Florida guidelines also set a maximum depth for carpet of 1/4in which is half the maximum height specified by UFAS.

Background Specifications for Accessible Route

General

UFAS (4.3.1 General)
All walks, halls, corridors, aisles, and other spaces that are part of an accessible route shall comply with 4.3.

Florida Children's Standards (3.1 General)
The standards governing accessible routes and circulation shall cover pathways, halls, aisles, waiting and gathering areas, decks and any paved or hard surfaces designed for general use by pedestrians. Unless specified differently, all standards shall apply to both exterior and interior spaces and routes and all accessible routes shall comply with this section.

Location and Placement

UFAS (4.3.2 Location)
(1) At least one accessible route within the boundary of the site shall be provided from public transportation stops, accessible parking, and accessible passenger loading zones, and public streets or sidewalks to the accessible building entrance they serve. (2) At least one accessible route shall connect accessible buildings, facilities, elements, and spaces that are on the same site. (3) At least one accessible route shall connect accessible building or facility entrances with all accessible spaces and elements and with all accessible dwelling units within the building or facility. (4) An accessible route shall connect at least one accessible entrance of each accessible dwelling unit with those exterior and interior spaces and facilities that serve the accessible dwelling unit.

Florida Children's Standards (3.2.1 Accessible Routes)
Accessible routes shall connect all accessible buildings, facilities, elements, and space within the site. Accessible routes shall be as direct as possible and connect all major entries and spaces. Handicapped users should not be forced to use secondary or rear entrances, nor should they be forced to take circuitous routes.

Florida Children's Standards (3.2.2 Exterior Accessible Routes)
Exterior accessible routes within the site shall be provided from public transportation stops, drop-off and loading zones, accessible parking, outdoor activity areas, and all public streets and sidewalks to the accessible building entrance(s).

Florida Children's Standards (3.2.3 Interior Accessible Routes)
Interior accessible routes shall connect all spaces and facilities within each structure that is designed for general use by children.

Florida Children's Standards (3.2.4 Exceptions to Accessible Routes)
Exceptions to accessible routes may be those areas that are not to be accessible to children for reasons of safety or security (such as service areas and mechanical rooms) or as a design decision adding to the health, safety and welfare of the children (such as separation of pedestrian and vehicular traffic or directing circulation).

Guidelines:

Preferred location and placement of accessible routes and entries is that of one barrier-free design used by everyone. Where necessary because of site constraints--not design decisions--separate handicapped accessible routes and entries may be used.

The health, safety and welfare of the users does not extend only to physical safety and comfort--it must also address social and psychological needs. The term "handicapped accessible" may be interpreted as providing separate facilities for the disabled. "Barrier-free" goes much further in that it declares no barriers of any sort for anyone, and everyone uses the same routes, entries, fixtures, and facilities as much as possible.

Width of Accessible Route

UFAS (4.3.3 Width)
The minimum clear width of an accessible route shall be 36in (915mm) except at doors (see 4.13.5) and passageways(UFAS Section 4.13.5 Doors - Clear Width) where 32in clear opening is provided.]

If a person in a wheelchair must make a turn around an obstruction, the minimum clear width of the accessible route shall be as shown in UFAS Fig. 7, pg.19.

If the point around which turn is to be made is less than 48in across, then the minimum clear width for wheelchair passage is 42in (1065mm), and must be 48in (1220mm) wide at the pivot point. For 90-degree turns around obstructions greater than 48in (1220mm), the minimum clear width for wheelchair passage is 36in (915).]

Florida Children's Standards (Exterior Accessible Route Widths)
(1) The minimum clear width for major accessible routes, such as those leading to main entrances, primary connections between buildings, and drop-off and loading areas is 7ft. The minimum clear width for secondary or minor exterior accessible routes shall be 5ft.

(2) Dimensions of the accessible route at entrances must comply with Section 3.13, Building Entrances.

Florida Children's Standards (Interior Accessible Route Widths)
(1) The minimum width of interior hallways shall be 9ft 6in.

(2) The minimum clear width of aisles, including any projections, shall be 44in.

(3) Dimensions of the accessible route at entrances must comply with Section 3.13, Building Entrances.

North Carolina Code
Corridors serving more than 2 classrooms: 8ft; more than 10 classrooms: 9ft; major high school corridors: 12ft (add 2ft for lockers along 1 wall, add 3ft for lockers along both walls). Minimum width approvable is 6ft, except for administrative areas, guidance areas, and locker rooms, which may be 5ft.

Passing and Resting Areas

UFAS (4.3.4 Passing Space)
If an accessible route has less than 60in (1525mm) clear width, then passing spaces at least 60in X 60in (1525mm by 1525mm) shall be located at reasonable intervals not to exceed 200ft (61 m). A T-intersection of two corridors or walks is an acceptable passing place.

UFAS (4.2.1 Wheelchair Passage Width)
The minimum clear width for single wheelchair passage shall be 32in (815mm) at a point and 36in (915mm) continuously. (See Fig. 1 and 24 (e)).

UFAS (4.2.2 Width for Wheelchair Passing)
The minimum width for two wheelchairs to pass is 60in (1525mm). (See Fig. 2).

Florida Children's Standards (3.4 Slopes and Gradients)
Gradients or slopes under 1:20 (5%) are considered walks. Gradients 1:20 and over are considered ramps and must comply with all ramp standards. Sustained slopes of 4% and greater shall have level rest areas that shall comply with Section 3.5, Exterior Passing and Rest Areas, as needed. Maximum distance between level areas or rest areas separated by slopes of 4% or greater shall be 100ft.

Florida Children's Standards (3.5 Exterior Passing and Resting Areas)
Level areas of a minimum 60in X 60in clear access shall be provided for resting and/or passing at intervals not to exceed 100ft. Included in this shall be a bench or seating element with a minimum of 60 lineal inches of seating and an open area for wheelchairs a minimum of 42in X 42in. (Florida Study Fig. 3.2, pg. 19.)

Clear Floor or Ground Space for Wheelchairs

UFAS (4.2.3 Wheelchair Turning Space)
The space required for a wheelchair to make a 180 degree turn is a clear space of 60in (1525mm) diameter (see Fig. 3 (a)) or a T-shaped space (see Fig. 3 (b)),

UFAS (4.2.4.1 Size and Approach)
The minimum clear floor or ground space required to accommodate a single, stationary wheelchair occupant is 30in X 48in (760mm by 1220mm) (see Fig. 4 (a)).
The minimum clear floor or ground space for wheelchairs may be positioned for forward or parallel approach to an object (see Fig.. 4 (b) and (c,)). Clear floor or ground space for wheelchairs may be part of the knee space required under some objects.

UFAS (4.2.4.2 Relationship of Maneuvering Clearance to Wheelchair Spaces)
One full unobstructed side of the clear floor or ground space for a wheelchair shall adjoin or overlap an accessible route or adjoin another wheelchair clear floor space. If a clear floor space is lo-

cated in an alcove or otherwise confined on all or part of three sides, additional maneuvering clearances shall be provided as shown in Fig. 4 (d) and (e).

UFAS (4.2.5 Forward Reach)
If the clear floor space only allows forward approach to an object, the maximum high forward reach allowed shall be 48in (1220mm) (see Fig. 5 (a)). The minimum low forward reach is 15in (380mm). If the high forward reach is over an obstruction, reach and clearances shall be shown in Fig. 5 (b).

ATBCB Children's Recommendations for Elementary Schools (1986)
The minimum low forward reach is 20in (510mm). The maximum high forward reach is 36in (915mm).

Slopes and Gradients

UFAS (4.3.7 Slope)
An accessible route with a running slope greater than 1:20 is a ramp and shall comply with 4.8 .Nowhere shall the cross slope of an accessible route exceed 1:50.

Florida Children's Standards (3.4 Slopes and Gradients)
Gradients or slopes under 1:20 (5%) are considered walks. Gradients 1:20 and over are considered ramps and must comply with all ramp standards. Sustained slopes of 4% and greater shall have level rest areas that shall comply with Section 3.5, Exterior Passing and Rest Areas, as needed. Maximum distance between level areas or rest areas separated by slopes of 4% or greater shall be 100ft.

Changes In Level

UFAS (4.3.8 Changes In Levels)
Changes in levels along an accessible route shall comply with 4.5.2. If an accessible route has changes in level greater than 1/2in in (13mm), then a curb ramp, ramp, elevator, or platform lift shall be provided that complies with 4.7, 4.8, 4.10, or 4.11, respectively. Stairs shall not be part of an accessible route.

UFAS (4.5.2 Changes In Level)
Changes in level up to 1/4in (6mm) may be vertical and without edge treatment (see Fig. 7 (c)).
Changes in level between 1/4in and 1/2in (6mm and 13mm) shall be beveled with a slope no greater than 1:2 (see Fig. 7 (d)).
Changes in level greater than 1/2in (13mm) shall be accomplished by means of a ramp that complies with 4.7 or 4.8.

Florida Children's Standards (3.6.2 Changes in Level)
Changes in level less than 1/4in may be vertical and without edge treatment. Changes in level between 1/4 and 1/2in shall be beveled with a slope no more than 1:2. Changes greater than 1/2in shall be treated as ramps and shall comply with standards set forth in Section 3.8 Ramps.

Florida Children's Standards (3.6.3 Joining or Abutment of Different Materials or Separate Elements)
All joining or abutment of materials shall be stable, firm, and non-movable. All edges shall be firmly attached and comply with the edge treatments specified in Section 3.6.2 Changes in Level.

Head Room

UFAS (4.3.5 Head Room)
Accessible routes shall comply with 4.4.2 .

Finishes and Materials

UFAS (4.5.1 General)
Ground and floor surfaces along accessible routes and in accessible rooms and spaces, including floors, walks, ramps, stairs, and curb ramps, shall be stable, firm, slip-resistant, and shall comply with 4.5.

UFAS (4.3.6 Surface Textures)
The surface of an accessible route shall comply 4.5 .

UFAS (4.2.4.3 Surfaces for Wheelchair Spaces)
Clear floor or ground spaces for wheelchairs shall comply with 4.5.

Florida Children's Standards (3.6 Finishes and Materials for Interior Accessible Routes)

Florida Children's Standards (3.6.1 General)
All surfaces, finishes and materials along accessible routes and in accessible rooms, spaces and facilities shall be stable, firm and slip-resistant and shall comply with all standards of this section.

Florida Children's Standards (3.6.2 Changes in Level)
Changes in level less than 1/4in may be vertical and without edge treatment. Changes in level between 1/4 and 1/2in shall be beveled with a slope no more than 1:2. Changes greater than 1/2in shall be treated as ramps and shall comply with standards set forth in Section 3.8 Ramps.

Florida Children's Standards (3.6.3 Joining or Abutment of Different Materials or Separate Elements)

All joining or abutment of materials shall be stable, firm, and non-movable. All edges shall be firmly attached and comply with the edge treatments specified in Section 3.6.2 Changes in Level.

Florida Children's Standards (3.6.4 Carpet)

If carpet or carpet tiles are used, then it shall be securely attached. It shall be taut with no waves or ripples under wheelchair use. All edges shall be firmly fastened to the floor and have trim along all exposed edges. All edges shall comply with Section 3.6.2, Changes in Level. the maximum pile height shall be 1/4 inch and shall be tightly and evenly woven with no sculptured surfaces. Carpet shall have a level loop--not cut--pile. the preferred situation is no cushion or pad, with the carpet glued to the floor surface to prevent rippling under wheelchairs, but if used, cushions, and pads, shall be firm. Changes in carpet color at stairs and ramps shall adhere to the respective requirements for treatment of landings.

Florida Children's Standards (3.6.5 Gratings)

If because of unavoidable site constraints, it is necessary to use grates or drains in the accessible surface, they shall not have spaces greater than 1/4 inch in one direction. If elongated openings are used, any gratings or drains occurring in the accessible route shall be positioned so that the long dimension is perpendicular to the primary direction of circulation. The preferred situation is that of no gratings within the accessible route.

Florida Children's Standards (3.6.6 Hygiene and Sanitation)

Carpet and all other flooring materials shall be able to withstand frequent cleaning with industrial or hospital strength cleansers.

Guidelines

. . . the range and frequency of incontinence, specialized medical treatment, lowered immunity, lack of refined motor skills, and other problems suggest that sanitation be one of the highest priorities in choosing flooring. The preferred choice of flooring materials is one that is easily cleaned, does not retain odors or moisture, and may be easily disinfected.

Florida Children's Standards (3.6.7 Corners)

Outside corners in hallways shall either be protected to a minimum height of 24 inches above the floor and a minimum of 6 inches laterally on each wall or the corner shall be rounded to a 2-foot minimum radius.

Florida Children's Standards (3.7 Finishes and Materials for Exterior Accessible Routes)

Florida Children's Standards (3.7.2 Choice of Materials and Specifications)

Paved and hard surfaces of all accessible routes and use areas shall be of an even surface, yet provide enough finish texture to provide safe footing in wet or dry conditions. Paved materials shall be firm and stable.

Acceptable surfaces of commonly used materials and finishes and their specifications for handicapped accessibility:

(1) Concrete shall have a medium broom or similarly textured finish. Any obvious grain shall run perpendicular to main flow of traffic.

(2) Concrete with exposed surface aggregate shall have fine to small aggregate.

(3) Wood decking shall have a maximum of 1/4in spacing between planks after shrinkage.

(4) Planking shall run perpendicular to main flow of traffic.

(5) Planking shall be installed bark side up.

(6) Individual pavers shall be set in mortar. Pavers on sand are not allowed.

(7) Asphalt shall be S-1 or S-2 grades.

Materials and finishes not conforming to the above standards (such as pavers on sand or coarse aggregates) may be used on school campuses as long as the minimum accessible route is maintained through and around them, and said non-conforming materials and finishes are safe for the general population. The preferred situation is use of accessible materials and finishes throughout the campus.

Joining or Abutment of Different Surfaces Along the Accessible Route (Florida Children's Standards)

Florida Children's Standards (3.7.4)

(1) All surfaces and materials immediately adjacent to the accessible routes and gathering areas, if not already defined and protected by railings, walls, or some physical barrier, shall be constructed and maintained so that the junction between differing materials and surfaces protects users from injury.

(2) Any vertical drop between joining or abutting surfaces of more than 6" but less than 18" shall be defined and protected by walls,

railings, or some other physical barrier of a minimum 12" in height. Any vertical drop of 18" or more shall be protected by a wall or guard rail of a minimum of 42" in height.

(3) Expansion and contraction joints shall be a maximum of 1/2" in width.

> Guidelines:
> The number of expansion joints within the accessible route should be kept to a minimum and should run perpendicular to the main flow of traffic as much as possible.

Florida Children's Standards (3.7.5)

(1) All junctions and abutments of the accessible route and accessible gathering areas to grass, planting beds, or any other form of soft surface shall follow all of the standards of this section if not already defined and protected by railings, walls or some physical barrier.

(2) Soil must be well-compacted and free of any organic material so as to avoid settlement problems later.

(3) Soil, grass, and planting beds must provide positive drainage away from the accessible route, but shall not fall away at more than a 3% gradient or slope for a minimum distance of 5' from the edge of the hard surface, thus providing a recovery area immediately adjacent to the accessible surface. (Fig. 3.3, pg. 23.)

(4) If a five-foot minimum recovery area is not possible between the accessible surface and retention, banks, or other slopes steeper than 3%, railings or some other form of physical barrier shall be used to protect children from the hazardous slope.

(5) Maximum vertical drop between the accessible hard surface and compacted soil to be planted with sod shall be 2" from the accessible surface edge to the compacted soil prior to sodding. If lawn is to be seeded, the maximum drop between the paving edge and compacted soil shall be 1/2". Maximum drop between paving and ground cover or shrubs shall be 1".

Carpet

UFAS (4.5.3 Carpet)

If carpet or carpet tile is used on a ground or floor surface, then it shall be securely attached; have a firm cushion, pad, or backing or no cushion or pad; and have a level loop, textured loop, level cut pile, or level cut/uncut pile texture. The maximum pile height shall be 1/2in (13mm). Exposed edges of carpet shall be fastened to floor surfaces and have trim along the entire length of the exposed *edge. Carpet edge trim shall comply with 4.5.2. If carpet tile is used on an accessible ground or floor surface, it shall have a maximum combined thickness of pile, cushion, and backing height of 1/2in (13mm) (see Fig. 8 (f)).*

Florida Children's Standards (3.6.4 Carpet)
If carpet or carpet tiles are used, then it shall be securely attached. It shall be taut with no waves or ripples under wheelchair use. All edges shall be firmly fastened to the floor and have trim along all exposed edges. All edges shall comply with Section 3.6.2, Changes in Level. the maximum pile height shall be 1/4 inch and shall be tightly and evenly woven with no sculptured surfaces. Carpet shall have a level loop--not cut--pile. the preferred situation is no cushion or pad, with the carpet glued to the floor surface to prevent rippling under wheelchairs, but if used, cushions, and pads, shall be firm. Changes in carpet color at stairs and ramps shall adhere to the respective requirements for treatment of landings.

Gratings

UFAS (4.5.4 Gratings)
If gratings are located in walking surfaces, then they shall have spaces no greater than 1/2in (13mm) wide in one direction (see Fig. 8 (g).
If gratings have elongated openings, then they shall be placed so that the long dimension is perpendicular to the dominant direction of travel (see Fig. 8 (h)).

Florida Children's Standards (3.6.5 Gratings)
If because of unavoidable site constraints, it is necessary to use grates or drains in the accessible surface, they shall not have spaces greater than 1/4 inch in one direction. If elongated openings are used, any gratings or drains occurring in the accessible route shall be positioned so that the long dimension is perpendicular to the primary direction of circulation. The preferred situation is that of no gratings within the accessible route.

Corners

Florida Children's Standards (3.6.7 Corners)
Outside corners in hallways shall either be protected to a minimum height of 24in above the floor and a minimum of 6in laterally on each wall or the corner shall be rounded to a 2ft minimum radius.

Doors

UFAS (4.3.9 Doors)
Doors along an accessible route shall comply with 4.13 .

Egress

UFAS (4.3.10 Egress)
Accessible routes serving any accessible space or element shall also serve as a means of egress for emergencies or connect to an accessible place of refuge. Such accessible routes and places of refuge shall comply with the requirements of the administrative authority having jurisdiction. Where fire code provisions require more than one means of egress from any space or room, then more than one accessible means of egress shall also be provided for handicapped people. Arrange egress so as to be readily accessible from all accessible rooms and spaces.

Ramps

Summary

Table 2 (following page) summarizes the quantitative requirements for various aspects of ramps (for children) as specified by the eight sources plus the UFAS.

Table 2
Ramps

		UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MS Guide	TX Code	Comments
4.8.1	Minimum Slope	1:20		1:20							
4.8.3	Minimum Clear Width	36"									
4.8.2	Maximum Slope	1:12		1:20 * 1:12 *							* Pre-Kindergarten 1 route * Primary School
	Maximum Rise	30"/run									
	Maximum Run			(1:12) 30', (< 1:12) 40							
4.8.6	Cross Slope	≤ 1:50		≤ 1:48							
4.8.4	Landing Length	60" min		60" min							
4.8.4	Landing Width	ramp width		ramp width							60" X 60" if turn
4.3.7	Edge Protection (Drop Off)	2" min		2" - 30"							
4.8.5	Handrails Required	rise > 6" run > 72"		> 6"							both sides ex. curb ramps
4.8.5	Railing Height	30" - 34" AFF	26" - 28" AFF	30" and 24"		26" - 28"					
4.8.5	Railing Extension	12"		12"							beyond end of ramp
4.8.5	Wall to Railing	1 1/2"		2"		1 1/2"					
4.21.2	Diameter of Railing	1 1/4" - 1 1/2"		1" - 1 1/4"		1 1/4"					
	Railing Load			200 lb							load at midpoint

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Comments related to Table 2

The two main differences in the provisions for children are a reduced slope for the ramp and lower heights for handrails. Two approaches are used for lower handrails, a lower height for one railing as compared to the UFAS and the use of two rails mounted at the minimum height for adults (as specified by UFAS) and a height of 24in.

The Florida guidelines have provisions for edge protection on ramps that are linked to the topography next to the ramp. The greater the distance from the ramp to the ground, the higher the requirement for edge protection.

Background Specifications for Ramps

General

UFAS (4.8.1 General)
Any part of an accessible route with a slope greater than 1:20 shall be considered a ramp and shall comply with 4.8 .

Florida Children's Standards (3.8.1 General)
Any part of an accessible route with a slope greater than 1:20 shall be considered a ramp and shall comply with this section. Curb ramps are a different classification and shall comply with Section 3.17, Curbs and Curb Ramps.

Clear Width

UFAS (4.8.3 Clear Width)
The minimum clear width of a ramp shall be 36in (915mm).

Slope

UFAS (4.8.2 Slope and Rise)
The least possible slope shall be used for any ramp. The maximum slope of a ramp in new construction shall be 1:12. The maximum rise for any run shall be 30in (760mm) (see Fig. 16). Curb ramps and ramps to be constructed on existing sites or in existing buildings or facilities may have slopes and rises as shown in table 2 if space limitations prohibit the use of a 1:12 slope or less (see 4.1.6).

SLOPE*	Max Rise		Max Run	
Run	in	mm	ft	mm
Steeper than 1:10 but no steeper than > 1:8.	3	75	2	0.6
Steeper than 1:12 but no steeper than > 1:10	6	150	5	1.5

* A slope steeper than 1:8 not allowed.

Florida Children's Standards (3.8.2 Slope)

For pre-kindergarten facilities, the maximum gradient of ramps shall be 1:20 for a minimum of one accessible route. For primary school facilities and for other accessible routes within pre-kindergarten facilities, the maximum gradient shall be 1:12.

Cross-Slopes and Surfaces

UFAS (4.8.6 Cross Slope and Surfaces)

The cross slope of ramp surfaces shall be no greater than 1:50. Ramp surfaces shall comply with 4.5 .

Florida Children's Standards (3.8.3 Cross-Slopes and Surfaces)

The cross-slope of ramp surfaces shall be no greater than 1:48. Surfaces shall comply with either Section 3.6, finishes and Materials on Interior Accessible Routes, or Section 3.7, finishes and Materials for Exterior Accessible Routes, according to the location of the ramp.

Landings

UFAS (4.8.4 Landings)

Ramps shall have level landings at the bottom and top of each run. Landings shall have the following features: (1) The landing shall be at least as wide as the ramp run leading to it. (2) The landing length shall be a minimum of 60in (1525mm) clear. (3) If ramps change direction at landings, the minimum landing size shall be 60in X 60in (1525mm X 1525mm). (4) If a doorway is located at a landing, then the area in front of the doorway shall comply with 4.13.6 .

Florida Children's Standards (3.8.5 Landings)

(1) Ramps shall have, at the top and bottom of each run, level landings or maneuvering spaces of a minimum length of 60in by the width of the ramp.

(2) Landings shall be at least as wide as the ramp run leading to it.

(3) Landings shall have a minimum of 60in clear access in length free of any obstructions, including handrails.

(4) If landings are used to change direction, the minimum landing size, free of any obstructions, including handrails, shall be 60in X 60in. (Fig. 3.4, pg. 25.)

(5) If the landing serves as an entry to a door, the area in front of the door shall comply with Section 3.13 Building Entrances.

(6) Landings shall be positively drained so as to not collect water.

Edge Protection

UFAS (4.8.7 Edge Protection)
Ramps and landings with drop-offs shall have curbs, walls, railings, or projecting surfaces that prevent people from slipping off the ramp. Curbs shall be a minimum of 2in (50mm) high (see Fig. 17).

Florida Children's Standards (3.8.6 Edge Protection)
(1) All ramps rising over 18in above grade shall have handrails, walls, or other physical barriers of a minimum height of 30in to prevent users from slipping off the ramp surface.

(2) If curbs are used along the sides of the ramp, they shall be a minimum of 2in high.

Guidelines:

Curbs are recommended as emergency wheelchair stops on exterior ramps, as long as they do not cause water to collect and/or flow along the ramp.

Handrails

UFAS (4.8.5 Handrails)
If a ramp run has a rise greater than 6in (250mm) or a horizontal projection greater than 72in (1830mm), then it shall have handrails on both sides. Handrails are not required on curb ramps. Handrails shall comply with 4.26 and shall have the following features: (1) Handrails shall be provided along both sides of ramp segments. The inside handrail on switchback or dogleg ramps shall always be continuous. (2) If handrails are not continuous, they shall extend at least 12in (305mm) beyond the top and bottom of the ramp segment and shall be parallel with the floor or ground surface. (3) The clear space between the handrail and the wall shall be 1.5in (38mm). (4) Gripping surfaces shall be continuous. (5) Top of handrail gripping surfaces shall be mounted between 30in and 34in (760mm and 865mm) above ramp surfaces. (6) Ends of handrails shall be either rounded or returned smoothly

to floor, wall, or post. (7) Handrails shall not rotate within their fittings.

ATBCB Children's Recommendations for Elementary Schools (1986)

UFAS 4.8 Ramps. All Provisions apply with the following addition. 4.8.5 Handrails is supplemented by: Top of handrail gripping surfaces for children shall be mounted between 26in and 28in (660mm and 710mm) above ramp surfaces.

Florida Children's Standards (3.8.7 Ramp Handrails)

(1) If a ramp has a rise greater than 6in or a horizontal run of 6ft or longer, it shall have handrails on each side. Curb ramps do not require handrails.

(2) All handrails shall comply with Section 3.9, Handrails.

Florida Children's Standards (3.9 Handrails)

Handrails used with ramps, steps, grade separations, separation of vehicular and pedestrian circulation, waiting areas, and along all accessible routes as needed to guide or protect users from hazards shall comply with this section.

Florida Children's Standards (3.9.1 Location and Placement)

(1) Handrails shall be installed at all ramps and steps.Curb ramps shall not be required to have handrails, unless they exceed requirements of Section 3.8.7, Ramp Handrails.

(2) Handrails shall be continuous along all ramps and steps, including both inside and outside turns of all landings used to change direction.

(3) Handrails shall continue a minimum of 12in beyond the ramp or steps into the level landing or maneuvering area. This extension shall be parallel with the ground surface.

(4) Handrails shall not extend into the accessible route and must be designed so that the top and bottom edges are rounded or immediately turn into the vertical support post or wall. (Fig. 3.5, pg. 28.)

(5) The actual gripping surface of the rail shall be continuous, and shall not be interrupted by vertical support posts, attachments to the wall, or any other obstructions. It shall also be free from abrasions, sharp or protruding elements, or other interruptions.

(6) The handrail design shall incorporate two separate handrail heights. The top handrail shall be 30in in height (above the sur-

face of the accessible route) and the lower handrail shall be 24in in height. Both handrails shall allow for continuous grasp of the rail.

(7) If the grade change from the ramp or step surface to the ground or paving is more than 18in, a 42in guardrail shall be incorporated into the handrail design as protection.

(8) The outside diameter of the handrails shall be a minimum of 1in and a maximum of 1.25in. (Fig. 3.6 a, pg. 28.)

(9) The clear space between the handrail and the wall shall be 2in. Handrails may be recessed within a wall if the recess extends a minimum of 12in above the rail and the clear space between the handrail and the wall is 3in. (Fig. 3.6 b, pg. 28.) Edges of the recess shall be rounded with a 1/2in minimum radius. The bottom of the recess shall be sloped for drainage and cleaning purposes.

(10) Vertical posts for handrail support shall be spaced with less than 6in clear space between infill supports. If a curb is not used, a minimum 2in bar shall be placed running parallel to the ramp at 2in above the ramp.

(11) Handrails shall be designed to support a minimum load of not less than 200 pounds applied horizontally or downward at the midpoint between supports.

Guidelines:

Recommended materials for exterior handrails are plastic or vinyl coatings or non-slip paints, as unvarnished wood splinters and metal can be very cold and slippery when wet. Also many types of pressure-treated woods are irritating to human skin.

Handrails are recommended wherever changes in the physical environment may cause confusion, require specific guidance in way-finding, or present hazards to users. They may also be used as leaning supports in areas where children may have to stand and wait.

North Carolina Code

An additional handrail shall be mounted not less than 26in nor more than 28in above the finished walking surface. The additional handrail may be integral with the adult-use handrail or may be mounted along its inside surface; if inside mounted, the hand clearance between the adult-use rail and the inner face of the children's handrail shall be 1.5in. The additional handrail shall have a width or diameter of 1.25in. North Carolina Building Code Appendix A-7, Ref. 4.1 c, pg. 222.

Handrails

Summary

Table 3 (following page) summarizes the quantitative requirements for various aspects of handrails (for children) as specifiied by the eight sources plus the UFAS.

Table 3
Handrails at Ramps

UFAS	Reference	UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.26.2	Diameter	1 1/4" - 1 1/2"		1" - 1 1/4"							
4.8.5 (3)	Off Wall	1 1/2"									
	Height AFF			30" and 24"			< 12 yrs - 24" CL	24" CL to floor *	28"		* In addition to other code heights
	Wall to Rail			2"							

Comments related to Table 3

Three of the state codes and the Florida guidelines have different height requirements as compared to the UFAS. The top limit is 30in which may be appropriate for older children while the minimum height is 24in. Florida is the only source to recommend two rail heights, 24in and 30in for all handrails, a recommendation which may work well for older children and some adults.

Background Specifications for Handrails

Location and Placement

UFAS (4.26.2 Size and Spacing of Grab Bars and Handrails)
The diameter or width of the gripping surfaces of a handrail or grab bar shall be 1.25in - 1.5in (32mm to 38mm), or the shape shall provide an equivalent gripping surface. If handrails or grab bars are mounted adjacent to a wall, the space between the wall and the grab bar shall be 1.5in (38mm) (see Fig. 39 (a), (b), and (c)). Handrails may be located in a recess if the recess is a maximum of 3in (75mm) deep and extends at least 18in (455mm) above the top of the rail (see Fig. 39 (d)).

Florida Children's Standards
(See Florida Children's Standards 3.9 Handrails page 24-25 of this report)

California
Where facilities are to be used solely by small children, the specific heights may be adjusted to meet their accessibility needs. If facilities are intended for use specifically for students which may include disabled users under 12 years of age, the following criteria shall be used: height of handrails shall be 2ft to the center of the bar from the floor surface.

Illinois 1978-88
In public facilities which primarily serve children, supplemental handrails shall be provided at a height of 2ft from the center of the bar to the floor surface (this does not supersede other code requirements for guard and hand rails at proper heights.).

Michigan
Handrails, water closets, lavatories, and accessories for small children such as schoolchildren, shall meet the requirements for their use. Michigan acknowledges that "this section is not as

specific as might be desirable", so the Barrier Free Division and the Plumbing Division suggest that handrails be placed so that the centerline (of the railing) is mounted 28in above the finished floor.

Stairs

Summary

Table 4 (following page) summarizes the quantitative requirements for various aspects of stairs (for children) as specified by the eight sources plus the UFAS.

Table 4
Stairs

UFAS	Reference	UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.9.2	Treads	≥ 11"		11"	60" - 144" wide						
4.9.3	Nosings	1/2" r. max		1/2" r. max							
4.9.3	Projections	1 1/2" max		1" max							
	Relative Riser Height			5 3/4"							
4.9.4	Handrail Height	30" - 34" above nosing	26" - 28" above nosing	30" and 24"							
	Width Between Handrails			≤ 88"							
	Warning Strips			36" deep; 36" X tread width							Visual and tactile; top & bottom of stair; texture, color and/or material
	Illumination			≥ 20 ft.candles							
	Landing Length			60" min							Middle landing
	Top and Bottom Landing			60" X 60" min							
	Steps			min 3/rise							Less than 3 steps req. ramp

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Comments related to Table 4

The requirements for handrail height is lower for stairs as it is for ramps. Florida continues the requirement for two separate handrail heights while the ATBCB supplement to the UFAS specify one railing mounted at 26in to 28in.

Florida has a number of requirements that were not specified by the other sources. These include warning strips at the top and bottom of stairs for visual and tactile use, a minimum level of illumination, specifications for minimum landing size for intermediate and top and bottom landings and a prohibition on the use of stairs when less than 3 steps were used on one run. The prohibition requires the use of ramps for changes in level that are separated by 3 steps or less.

The North Carolina Department of Education has a minimum requirement for width of stair treads of 60in and a maximum of 144in. No other code or standard had such a requirement for accessibility. This requirement is probably based in egress requirements and fire safety guidelines.

Background Specifications for Stairs

General

UFAS (4.9.1 Minimum Number)
Stairs required to be accessible by 4.1 shall comply with 4.9.

Florida Children's Standards (3.10.1 General)
All stairs, including those which are an alternative to either elevators or wheelchair lifts, shall comply with the standards of this section. (The only exceptions to these standards may be steps which ar obiviously a part of therapeutic play areas--and not the only access to these play areas--or amphitheater seating steps which shall be accessible by conforming access stairs and ramps.) Stairs and steps shall not be considered a part of the accessible route, but may be used as an additional alternative to other, accessible means of access over changes in grades.

Treads and Risers

UFAS (4.9.2 Treads and Risers)
On any given flight of stairs, all steps shall have uniform riser heights and uniform tread widths. Stair treads shall be no less than 11in (280mm) wide, measured from riser to riser (see Fig. 18 (a)). Open risers are not permitted on accessible routes.

Florida Children's Standards (3.10.2 Treads and Risers)
(1) Within any set of stairs, all steps shall have uniform riser heights and tread depths. Treads and risers of stairs shall be so proportioned that the sum of 2 risers and a tread is not less than 24in or more than 25in. Treads shall be no less than 10in in length with a 1in nosing. Tread length shall be measured from nosing to nosing.

(2) Open risers are not acceptable in any targeted facility, interior or exterior. Any gap between the riser and tread (such as the spacing between wooden planks in exterior stairs) must be less than 1/2in in width and shall occur in the height of the riser - not in the length of the tread.

(3) A warning strip shall be placed at the top and bottom landings for visual and tactile warnings. This strip shall be a minimum of 36in deep by the full stair width, and shall consist of contrasting texture and color and/or materials.

Nosings

UFAS (4.9.3 Nosings)
The undersides of nosings shall not be abrupt. The radius of curvature at the leading edge of the tread shall be no greater than 1/2in (13mm). Risers shall be sloped or the underside of the nosing shall have an angle not less than 60 degrees from the horizontal. Nosings shall project no more than 1.5in (38mm) (see Fig. 18).

Florida Children's Standards (3.10.3 Nosings)
Risers shall be sloped or shall have nosings. Nosings shall comply with the following standards:

(1) The undersides of nosings shall not be abrupt. Nosings shall have rounded undersides at an angle of not less than 60 degrees from the horizontal.

(2) The radius of curvature at the leading edge of the tread shall be no greater than 1/2in.

(3) Nosings shall project no more than 1in beyond the lower tread. (Fig. 3.7, pg. 30.)

Guidelines:
It is strongly recommended that all nosings have a contrasting texture and color and/or material to distinguish them from the rest of the accessible route. Non-slip textures are also necessary for the entire tread. It is recommended that riser heights be limited to 5.75in in height in targeted facilities.

Handrails

UFAS (4.9.4 Handrails)
Stairways shall have handrails at both sides of all stairs. Handrails shall comply with 4.26 and shall have the following features:
(1) Handrails shall be continuous along both sides of stairs. The inside handrail on switchback or dogleg stairs shall always be continuous (see Fig. 19 (a) and (b).pg. 29.)

(2) If handrails are not continuous, they shall extend at least 12in (305mm) beyond the top riser and at least 12in (305mm) plus the width of one tread beyond the bottom riser. At the top, the extension shall be parallel with the floor or ground surface. At the bottom, the handrail shall continue to slope for a distance of the width of one tread from the bottom riser; the remainder of the extension shall be horizontal (see Fig. 19 (c) and (d)). Handrail extensions shall comply with 4.4.pg. 29.)

(3) The clear space between handrails and wall shall be 1.5in (38mm).

(4) Gripping surfaces shall be uninterrupted by newel posts, other construction elements, or obstructions.

(5) Top of handrail gripping surface shall be mounted between 30in and 34in (760 and 865mm) above stair nosings.

(6) Ends of handrails shall be either rounded or returned smoothly to floor, wall, or post.

(7) Handrails shall not rotate within their fittings.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.9 Stairs. All Provisions apply with the following addition. 4.9.4 Handrails is supplemented by: Top of handrail gripping surfaces for children shall be mounted between 26in and 28in (660mm and 710mm) above stair nosings.

Florida Children's Standards (3.10.4 Handrails)
(1) All stairs designed for public access shall have handrails at both sides of the stairs. The maximum between handrails shall be 88in. If the width of the stairs exceeds 88in, another handrail shall be installed, centered, within the width.

(2) All handrails must comply with the standards of 3.9, Handrails.

North Carolina Code
An additional handrail shall be mounted not less than 26in nor more than 28in above the slope of the stair (the common line of the stair nosings). The additional handrail may be integral with the adult-use handrail or may be mounted along its inside surface; if inside-mounted, the hand clearance between the adult-use rail and the inner face of the children's handrail shall be 1.5in. The additional handrail shall have a width or diameter of 1.25in. Note: Handrails for children, if mounted along the inside surface of the adult-use handrail, shall not reduce the required width of any required stair or ramp. North Carolina Building Code Appendix A-8, Ref. 4.4.1, pg. 223.

Stair Width

Florida Children's Standards
The clear width of all stairs must conform to the minimum widths for accessibility for interior and exterior accessible routes.

Warning Strips

UFAS (4.9.5 Tactile Warnings at Stairs)
(Removed and reserved).

UFAS (4.29.4 Tactile Warnings at Stairs)
(Reserved).

Florida Children's Standards (3.10.7 Warning Strips)
The top and bottom landings shall be distinguished by changes in texture, color, and/or material. The minimum size of this warning shall be 36in deep by the full stair width. (Fig. 3.8, pg. 32.)

Illumination

Florida Children's Standards (3.10.8 Stairs Illumination)
A minimum of 20 foot candles shall light interior and exterior stairs within public access routes. Lighting shall not cast shadows on or over treads.

Landings and Number of Steps

Florida Children's Standards (3.10.6 Landings and Number of Steps)
(1) Level landings of a minimum clear length of 60in shall be used to change direction in stairs and to break up the number of steps. A 60 in X 60in minimum level landing shall occur at the top and bottom of stairs. (Fig. 3.8, pg. 32.)

(2) The minimum number of steps in any one set of stairs or in any one rise shall be three. Any change in level not meeting this re-

quirement shall be accessed by ramps complying with Section 3.8 Ramps.

(3) Stairs in targeted facilities shall have no more than a 6ft rise without a landing break.

Wheelchair Lifts

Location and Placement

UFAS (4.11.1 Location)
Platform lifts permitted by 4.1 shall comply with the requirements of 4.11.

Florida Children's Standards (3.11.1 Location and Placement)
Wheelchair lifts may be used in modifying existing facilities. Their use in new construction is not recommended except for auditorium and stage situations. All lifts shall be clearly marked "for handicapped use only".

Florida Children's Standards (3.11.2 Climatic Protection)
Both levels of any exterior lift shall be protected from inclement weather.

Entrances

UFAS (4.11.3 Entrance)
If platform lifts are used, then they should facilitate unassisted entry and exit from the lift in compliance with 4.11.2.

Safety Specifications

UFAS (4.11.2 Other Requirements)
If platform lifts are used, they shall comply with 4.2.4, 4.5, 4.27, and the applicable safety regulations of administrative authorities having jurisdiction.

Florida Children's Standards (3.11.3 Safety Specifications)
Wheelchair lifts complying with regulations of the Office of Educational Facilities may be used as part of an accessible route and shall adhere to the standards of this code covering width, vertical drop between surfaces, reach, and accessible routes.

Elevators

Summary

Table 5 (following page) summarizes the quantitative requirements for various aspects of elevators (for children) as specified by the eight sources plus the UFAS.

Table 5
Elevators

UFAS	Reference		UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.10.2	Cab to Floor Landing		1/2" max		1/4"							Automatic operation
4.10.3	Call Buttons	AFF	42" CL	34"	34" - 36"							
4.10.3	Call Button Minimum Size		3/4"		1" ** & 2" O.C.†							**min. diameter, †spacing O.C
4.10.4	Hall Lanterns	AFF	72" CL 2 1/2" in smallest direction		60" CL 2 1/2" in smallest direction		72" min					Visual and auditory
4.10.5	Hoistway Entrance Markings	AFF	60" CL	By designer*	42" CL		40" CL					Raised characters
4.10.6	Door Reopening Device	AFF	5" and 29"		5" and 29"							
4.10.6	Doors Open After Reopening		20 sec min		20 sec min							
4.10.8	Door Delay		min 3 secs		min 10 secs							After car is called
4.10.9	Car Platform Sill to Edge of Hoistway		max 1 1/4"									
4.10.9	Minimum Cab Size - Side Door		51" X 68"									Size by bldg. size
4.10.9	Minimum Cab Size - Centered Door		51" X 80"									
4.10.9	Minimum Door Width		36" min									
4.10.12	Car Control Buttons	AFF	54" max	36" max	36" max							
4.10.12	Emergency Buttons	AFF	min 35"		min 23"							Duplication may be needed for adult use
4.10.14	Emergency Communications	AFF	48" max	36" max	36" max-23" min		36" max					
4.10.14	Phone Cord Length		29" min		36" min							If handset used

* 60" height is too high for tactile use by children.

Comments related to Table 5

The Florida guidelines, the North Carolina Building Code and the ATBCB supplements to the UFAS generally specify lower heights for call buttons, a larger size for these buttons, lower heights for lanterns and markings.

The Florida guidelines also specify a longer delay for the doors to close once the elevator is called.

Background Specifications for Elevators

General

UFAS (4.10.1 General)
Accessible elevators shall be on an accessible route and shall comply with 4.10 Elevators and with the American National Standard Safety Code for Elevators, Dumbwaiters, Escalators and Moving Walks, ANSI A17.1-1978 and A17.1a-1979. This standard does not preclude the use of residential or fully enclosed wheelchair lifts when appropriate and approved by administrative authorities. Freight elevators shall not be considered as meeting the requirements of this section, unless the only elevators provided are used as combination passenger and freight elevators for the public and employees.

Florida Children's Standards (3.12.1 General)
Passenger elevators on accessible routes shall comply with ANSI/ASME A17.1 - 1984 and A17.1a - 1985. Freight elevators used as combination passenger and freight elevators, can be considered as meeting the requirements of this section if access to them is on accessible routes used by the general population.

Automatic Operations

UFAS (4.10.2 Automatic Operation)
Elevator operation shall be automatic. Each car shall be equipped with a self-leveling feature that will automatically bring the car to floor landings within a tolerance of 1/2in (13mm) under rated loading to zero loading conditions. This self-leveling feature shall be automatic and independent of the operating device and shall correct the overtravel or undertravel.

Florida Children's Standards (3.12.2 Automatic Operations)
Elevator operation shall be automatic. Each car shall be equipped with a self-leveling feature that will automatically bring the car to

floor landings within a tolerance of 1/4 inch under rated loading to zero loading conditions. This self-leveling feature shall be automatic and independent of the operating device and shall correct the overtravel and undertravel.

Hall Call Buttons

UFAS (4.10.3 Hall Call Buttons)
Call buttons in elevator lobbies and halls shall be centered at 42in (1065mm) above the floor. Such call buttons shall have visual signals to indicate when each call is registered and when each call is answered. Call buttons shall be a minimum of 3/4in (19mm) in the smallest dimension. The button designating the up direction shall be on top (see Fig. 20). Buttons shall be raised or flush. Objects mounted beneath hall call buttons shall not project into the elevator lobby more than 4in (100mm).

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.10. Elevators. All Provisions apply with the following addition.
4.10.3 Hall Call Buttons is supplemented by: Call buttons in elevator lobbies and halls which are to be used by children shall be centered at 34in (865mm) above the floor. The button designating the up direction shall be on top.

Florida Children's Standards (3.12.3 Hall Call Buttons)
Call buttons in elevator lobbies and halls shall be centered at 36in above the floor. Such call buttons shall have visual and audible signals to indicate when each call is registered and when each call is answered. Call buttons shall be a minimum of 1in in the smallest dimension, a minimum of 2in on center and have a tactile indicator for up and down. The button designating the up direction shall be on top. (Fig. 3.9, pg. 34.)

North Carolina Code
The horizontal centerline of hall call buttons shall not be lower than 34in nor higher than 36in above the finished floor or ground level. (North Carolina Building Code Appendix A-14, Ref. 4.9.6 (a) (1), pg. 229.)

Hall Lanterns

UFAS (4.10.4 Hall Lanterns)
A visible and audible signal shall be provided at each hoistway entrance to indicate which car is answering a call. Audible signals shall sound once for the up direction and twice for the down direction or shall have verbal annunciators that say "up" or "down". Visible signals shall have the following features: (1) Hall lantern fixtures shall be mounted so that their centerline is at least 72in

(1830mm) above the lobby floor. (2) Visual elements shall be at least 2.5in (64mm) in the smallest direction. (3) Signals shall be visible from the vicinity of the hall call button. In-car lanterns located in cars, visible from the vicinity of hall call buttons, and conforming to the above requirements, shall be acceptable (see Fig. 20).

Florida Children's Standards (3.12.4 Hall Lanterns)
A visible and audible signal shall be provided at each hoistway entrance to indicate which car is answering a call. Audible signals shall sound once for the up direction and twice for the down direction or shall have verbal annunciators that say "up" or "down". Visible signals shall have the following features:

(1) Hall lantern fixtures shall be mounted so that their centerline is at a maximum of 60 inches above the lobby floor. The lantern shall not protrude into the circulation space as indicated in Section 3.19, Protruding Objects.

(2) Visual elements shall be at least 2-1/2 in (64mm) in the smallest direction.

(3) Signals shall be visible from the vicinity of the hall call button. In-car lanterns located in cars, visible from the vicinity of hall call buttons, and conforming to the above requirements, shall be acceptable. (Fig. 3.9, pg. 34.)

Guidelines:
The hall lantern should be in the visual range for those children with restricted head movement and reduced peripheral vision.

North Carolina Code
North Carolina Building Code Appendix A-14, pg. 229.

Hoistway Entrance Markings

North Carolina Code
The floor designation provided at each hoistway shall have its horizontal centerline at 40in above the finished floor or ground level.
North Carolina Building Code Appendix A-14, Ref. 4.9.6 (c) (2), pg. 229.

Raised Characters on Hoistway Entrances

UFAS (4.10.5 Raised Characters on Hoistway Entrances)
All elevator hoistway entrances shall have raised floor designations provided on both jambs. The centerline of the characters

shall be 60in (1525mm) from the floor. Such characters shall be 2in (50mm) high and shall comply with 4.30. Permanently applied plates are acceptable if they are permanently fixed to the jambs. (See Fig. 20).

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.10. Elevators. All Provisions apply with the following addition.
4.10.5 Raised Characters on Hoistway Entrances is supplemented by: The mounting height specified by UFAS for raised characters on hoistway entrances is not appropriate for tactile use by children. Designers may propose modifications to UFAS based on the particular population served by a given elevator, or they may propose mounting supplementary characters at a lower height.

North Carolina Code
Characters on hoistway entrances shall be raised.

Florida Children's Standards (Raised Characters on Hoistway Entrances)
All elevator hoistway entrances shall have raised floor designations provided on both jambs. The centerline of the characters shall be a maximum height of 42in from the floor. Such characters shall be a nominal 2in in height and shall comply with Section 3.20 Signage. Permanently applied plates are acceptable if they are permanently fixed to the jambs. (Figure 3.9, pg. 34.)

Door Protective and Reopening Device

UFAS (4.10.6 Door Protective and Reopening Device)
Elevator doors shall open and close automatically. They shall be provided with a reopening device that will stop and reopen a car door and hoistway door automatically if the door becomes obstructed by an object or person. The device shall be capable of completing these operations without requiring contact for an obstruction passing through the opening at heights of 5in and 29in (125mm and 735mm) from the floor (see Fig. 20). Door reopening devices shall remain effective for at least 20 seconds. After such an interval, doors may close in accordance with the requirements of ANSI A17.1-1978 and A17.1a -1979.

Florida Children's Standards (3.12.6 Door Protective and Reopening Device)
Elevator doors shall open and close automatically. They shall be provided with a reopening device that will stop and reopen a car door and hoistway door automatically if the door becomes obstructed by an object or person. The device shall be capable of completing these operations without requiring contact for an ob-

struction passing through the opening at heights of 5 inches and 29 inches from the floor. It shall not require physical contact to be activated, although contact may occur before the door reverses. (Fig. 3.9, pg. 34). Door reopening devices shall remain effective for at least 20 seconds. After such an interval, doors may close in accordance with the requirements of ANSI A17.1-1984 and A17.1a1985.

Door and Signal Timing for Hall Calls

UFAS (4.10.7 Door and Signal Timing for Hall Calls)
The minimum acceptable time from notification that a car is answering a call until the doors of that car start to close shall be calculated from the following equation: $T=D/1.5$ ft/s or $T= D/445$mm/s, where T = total time in seconds and D = distance (in feet or millimeters) from a point in the lobby or corridor 60in (1525mm) directly in front of the farthest call button controlling that car to the centerline of its hoistway door (see Fig. 21). For cars with in-car lanterns, T begins when the lantern is visible from the vicinity of hall call buttons and an audible signal is sounded. The minimum acceptable notification time shall be 5 seconds.

Florida Children's Standards (3.12.7 Door and Signal Timing for Hall Calls)
The acceptable time from notification that a car is answering a call until the doors of that car start to close shall be a minimum of 20 seconds.

Door Delay for Car Calls

UFAS (4.10.8 Door Delay for Car Calls)
The minimum time for elevator doors to remain fully open in response to a car call shall be 3 seconds.

Florida Children's Standards (3.12.8 Door Delay for Car Calls)
The minimum time for elevator doors to remain fully open in response to a car call shall be 10 seconds.

Floor Plan for Elevator Cars

UFAS (4.10.9 Floor Plan of Elevator Cars)
The floor area of elevator cars shall provide space for wheelchair users to enter the car, maneuver within reach of controls, and exit from the car. Acceptable door opening and inside dimensions shall be as shown in Fig. 22. The clearance between the car platform sill and the edge of any hoistway landing shall be no greater than 1.25in (32mm).

Florida Children's Standards (3.12.9 Floor Plan of Elevator Cars)
The floor area of elevator cars shall provide space for wheelchair users to enter the car, maneuver within reach of controls, and exit from the car. Acceptable door opening and inside dimensions shall be as shown in Figure 3.10, pg. 34. The clearance between the car platform sill and the edge of any hoistway landing shall be no greater than 1in.

Guidelines:

Some multiple handicapped children may need to be moved in the prone position. Choice of elevator size should take this into consideration.

Floor Surfaces

UFAS (4.10.10 Floor Surfaces)
Floor surfaces shall comply with 4.5.

Florida Children's Standards (3.12.10 Floor Surfaces)
Floor surfaces shall have the following features:

(1) Floor surfaces shall be stable, firm and slip-resistant.

(2) If carpet or carpet tile is to be used on the floor for surface, it shall comply with Section 3.6.4 Carpet.

Illumination Levels

UFAS (4.10.11 Illumination Levels)
The level of illumination at the car controls, platform, and car threshold and landing sill shall be at least 5 footcandles (53.8 lux).

Florida Children's Standards (3.12.11 Illumination Levels)
The level of illumination at the car controls, platform, and car threshold and landing sill shall be at least ten footcandles.

Car Controls

UFAS (4.10.12 Car Controls)
Elevator control panels shall have the following features:
(1) Buttons. All control buttons shall be at least 3/4in (19mm) in their smallest dimension. They may be raised or flush.
(2) Tactile and Visual Control Indicators. All control buttons shall be designated by raised standard alphabet characters for letters, Arabic characters for numerals, or standard symbols as shown in Fig. 23 (a), and as required by ANSI A17.1-1978 and A17.1a-1979. Raised characters and symbols shall comply with 4.30. The

call button for the main entry floor shall be designated by a raised star at the left of the floor designation (see Fig. 23 (a)). All raised designations for control buttons shall be placed immediately to the left of the button to which they apply. Applied plates, permanently attached, are an acceptable means to provide raised control designations. Floor buttons shall be provided with visual indicators to show when each call is registered. The visual indicators shall be extinguished when each call is answered.
(3) Height. All floor buttons shall be no higher than 48in (1220mm), unless there is substantial increase in cost, in which case the maximum mounting height may be increased to 54in (1370mm), above the floor. Emergency controls, including the emergency alarm and emergency stop, shall be grouped at the bottom of the panel and shall have their centerlines no less than 35in (890mm) above the floor (see Fig. 23 (a) and (b)).
(4) Location. Controls shall be located on a front wall if cars have center opening doors, and at the side wall or at the front wall next to the door if cars have side opening doors (see Fig. 23(c) and (d)).

ATBCB Children's Recommendations for Elementary Schools (1986)

UFAS 4.10. Elevators. All Provisions apply with the following addition.
4.10.12 Car Controls is supplemented by: All floor buttons to be used by children shall be no higher than 36 in (915mm) above the floor.

Florida Children's Standards (3.12.12 Car Controls)

Elevator controls panels shall have the following features:

(1) Buttons. All control buttons shall be at least 1in in their smallest dimension. They may be raised or flush.

Buttons shall be arranged with numbers in ascending order as shown in Fig. 3.11 a, pg. 37, and shall read from left to right.

(2) Tactile and Visual Control Indicators. All control buttons shall be designated by raised standard alphabet characters for letters, Arabic characters for numerals, or standard symbols as shown in Figure 3.11 a, pg. 37, and as required by ANSI/ASME A17.1 - 1984 and A17.1a - 1985. Raised characters and symbols shall comply with Section 3.20 Signage. The call button for the main entry floor shall be designated by a raised star at the left of the floor designation (Figure 3.11 a, pg. 37). All raised designations for control buttons shall be placed immediately to the left of the button to which they apply. Applied plates, permanently attached, are an acceptable means to provide raised control designations. Floor buttons shall be provided with visual indicators to show

when each call is registered. The visual indicators shall be extinguished when each call is answered.

(3) Height . All floor buttons shall be no higher than 36in above the floor. Emergency controls, including the emergency alarm and emergency stop, shall be grouped at the bottom of the panel and shall have their centerlines no less than 23in above the floor. (Fig. 3.11 a, pg. 37.)

(4) Location. Controls shall be located on a front wall if cars have center opening doors, and at the side wall or at the front wall next to the door if cars have side opening doors. (Figs. 3.11 b & c, pg. 37.)

Guidelines:

Because of the physical difference in height and reach between adults, handicapped adults and young handicapped children, some of these dimensions may be in conflict with adult requirements. Duplication in certain equipment and controls may be necessary. The preferred height for controls is 32in.

North Carolina Code

All operating controls, buttons and emergency signaling devices shall be mounted no higher than 36in above the finished floor. North Carolina Building Code Appendix A-13, Ref. 4.9.5 (a), pg. 228. Elevator standard symbols as required by ANSI/ASME A17.1 and A17.1A.

Car Position Indicators

UFAS (4.10.13 Car Position Indicators)

In elevator cars, a visual car position indicator shall be provided above the car control panel or over the door to show the position of the elevator in the hoistway. As the car passes or stops at a floor served by the elevators, the corresponding numerals shall illuminate, and an audible signal shall sound. Numerals shall be a minimum of 1/2in (13mm) high. The audible signal shall be no less than 20 decibels with a frequency of no higher than 1500 Hz. An automatic verbal announcement of the floor number at which a car stops or which a car passes may be substituted for the audible signal.

Florida Children's Standards (3.12.13 Car Position Indicators)

In elevator cars, a visual car position indicator shall be provided above the car control panel or over the door to show the position of the elevator in the hoistway. As the car passes or stops at a floor served by the elevators, the corresponding numerals shall illuminate, and an audible signal shall sound. Numerals shall be a minimum of 1/2 inch high. The audible signal shall be no less than 20 decibels with a frequency of no higher than 1500 Hz. An automatic verbal announcement of the floor number at which a car stops or which a car passes may be substituted for the audible signal.

Emergency Communications

UFAS (4.10.14 Emergency Communications)

If provided, emergency two-way communication systems between the elevator and a point outside the hoistway shall comply with ANSI A17.1-1978 and A17.1a-1979. The highest operable part of a two-way communication system shall be a maximum of 48in (1220mm) from the floor of the car. It shall be identified by a raised or recessed symbol and lettering complying with 4.30 and located adjacent to the device. If the system uses a handset, then the length of the cord from the panel to the handset shall be at least 29in (735mm). If the system is located in a closed compartment, the compartment door hardware shall conform to 4.27, Controls and Operating Mechanisms. The emergency intercommunication system shall not require voice communication.

ATBCB Children's Recommendations for Elementary Schools (1986)

UFAS 4.10. Elevators. All Provisions apply with the following addition.

4.10.14 Emergency Communications is supplemented by: The highest operable part of a two-way communication system to be used by children shall be a maximum of 36 inches (915mm) from the floor of the car. It shall be identified by a raised or recessed symbol and lettering complying with 4.30 (Signage) as supplemented by these recommendations (ATBCB Children's Recommendations for Elementary Schools (ATBCB)), and located adjacent to the device. If the system is located in a closed compartment, the compartment door hardware shall conform to UFAS Section 4.27 Controls and Operating Mechanisms, as supplemented by these (ATBCB) recommendations.

Florida Children's Standards (3.12.14 Emergency Communications)

Car emergency signalling devices shall be provided and shall have the following features:

(1) The highest operable part of an emergency communication system shall be a maximum of 36in above the floor and no lower than 23in above the floor.

(2) If the system is located in a closed compartment, the compartment door hardware shall be operable with one hand and not require tight grasping, pinching or twisting of the wrist.

(3) It shall be identified by raised symbols and lettering complying with Building Standards for Educational Facilities for Handicapped Children Section 3.20 Signage, and be located adjacent to the device.

(4) If the system uses a handset, then the length of the cord from the panel to the handset shall be at least 36in.

(5) The car emergency signaling device shall not be limited to voice communication.

(6) If instructions for use are provided, essential information shall be presented in both tactile and visual form.

North Carolina Code
North Carolina Building Code Appendix A-13, Ref. 4.9.5 (a), pg. 228. Emergency telephones may be mounted in any location, but never higher than 36in above the cab floor.

Handrails

Florida Children's Standards (3.9
A handrail shall be provided on all walls without doors and have the following features:

(1) The clear space between the handrail and the wall shall be 2 inches.

(2) The diameter or width of the gripping surfaces of the handrail shall be 1 inch to 1 1/4 inches, or the shape shall provide an equivalent gripping surface.

(3) A dual handrail system shall be provided with the upper gripping surface mounted between 30in and 34in for adults and the lower gripping surface mounted between 26in and 28in for children. Spacing between the rails should ensure access to both. [Fig 3.12]

Building Entrances

General

Florida Children's Standards (3.13.1 General)
All accessible building entrances are part of the accessible route and shall comply with this section and with Section 3.0, Accessible Routes. The accessible entrance(s) shall be connected by an accessible route to all spaces and facilities within the building. It shall also be connected by an accessible route to accessible

parking, public transportation stops, public streets and sidewalks, loading and drop-off zones, and other buildings and facilities within the site.

Minimum Number

UFAS (4.14.1 Minimum Number)
Entrances required to be accessible by 4.1 shall be part of an accessible route and shall comply with 4.3. Such entrances shall be connected by an accessible route to public transportation stops, to accessible parking and passenger loading zones, and to public streets or sidewalks if available (see 4.3.2 (1)). They shall also be connected by an accessible route to all accessible spaces or elements within the building or facility.

Service Entrances

UFAS (4.14.2 Service Entrances)
A service entrance shall not be the sole accessible entrance unless it is the only entrance to a building or facility (for example, in a factory or garage).

Doors

Summary

Table 6 (following page) summarizes the quantitative requirements for various aspects of doors (for children) as specified by the eight sources plus the UFAS.

Table 6
Doors

UFAS	Reference	UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.13.5	Minimum Door Width	32" clear		36" min door							when door is open 90 degrees
	Minimum Width - Openings > 24" Deep	36"									
	Width - Non-Passage Doors (closet)	20" min									e.g., shallow closets
4.13.6	Maneuvering Clearance	Fig. 25		48" - 60" width of door plus 18" width							
4.13.7	Doors in a Series	48" and door width if swing into space		48" and door width if swing into space							* sliding doors only, others 1/2"
4.13.8	Thresholds - Exterior	3/4" max*		1/2" max ht							beveled < 1:2
4.13.8	Thresholds - Interior	1/2" max height		1/2" max ht							
4.13.9	Door Hardware AFF	48" max	36" max	30" - 34"		30" max					
4.13.10	Closer Time	3 sec min		20 sec							time - 70 degrees to 3" 90 degrees to 12 degrees
4.13.11	Force - Push or Pull - Exterior	reserved		5 lbf							
4.13.11	Force - Push or Pull - Interior	5 lbf		5 lbf							
4.13.12	Automatic Doors - Open to Back Check	3 sec max		3 sec max							
4.13.12	Automatic Doors - Force to Stop	15 lbf		15 lbf							
	Kickplates AFF			to 18"							

Table 6: Doors

Review of selected codes, standards and guidelines: Chapter One, p. 45

Comments related to Table 6

Some of Florida's guidelines for doors differ from the UFAS, the North Carolina Code or the ATBCB supplements. Florida specifies a 36in minimum door width rather than a 32in clear door opening. Florida also specifies a longer delay for the door closer (measured differently from the UFAS) 20 seconds vs 3 seconds (UFAS) and the installation of a kick-plate of the door.

The height of door hardware (levers or locksets) specified by the ATBCB supplement, the Florida standards and the North Carolina Code is lower than for the UFAS. The range varies significantly from a 30in maximum for North Carolina to a 36in maximum for the ATBCB supplement. Florida specifies a height range from 30in to 34in.

Background Specifications for Doors

General

UFAS (4.13.1 General)
Doors required to be accessible by 4.1 shall comply with the requirements of 4.13.

Revolving Doors and Turnstiles

UFAS (4.13.2 Revolving Doors And Turnstiles)
Revolving doors or turnstiles shall not be the only means of passage at an accessible entrance or along an accessible route. An accessible gate or door shall be provided adjacent to the turnstile or revolving door and shall be so designed as to facilitate the same use pattern.

Florida Children's Standards (3.14.2 Revolving Doors and Turnstiles)
Revolving doors and turnstiles shall not be used as primary entrances and exits in new construction. If used in retrofitting existing structures, they shall not be the sole means of access. Alternative accessible entrances and routes shall be immediately adjacent to the revolving doors or turnstiles.

Gates

UFAS (4.13.3 Gates)
Gates, including ticket gates, shall meet all applicable specifications of 4.13.

Double-leaf Doors

UFAS (4.13.4 Double-Leaf Doorways)
If doorways have two independently operated door leaves, then at least one leaf shall meet the specifications in 4.13.5 and 4.13.6. That leaf shall be an active leaf.

Florida Children's Standards (3.14.4 Double-leaf Doors)
If doorways have two independently operated door leaves, then at least one leaf shall meet the specifications in Section 3.14 Doors, as long as the doorway meets the total width of egress requirements. Non-accessible door leaves may be used when leading to non-accessible or hazardous areas such as mechanical rooms and service areas.

Width

UFAS (4.13.5 Clear Width)
Doorways shall have a minimum clear opening of 32in (815mm) with the door open 90 degrees, measured between the face of the door and the stop (see Fig. 24 (a), (b), (c), and (d)). Openings more than 24in (610mm) in depth shall comply with 4.2.1 and 4.3.3 (see Fig. 24 (e)). EXCEPTION: Doors not requiring full user passage, such as shallow closets, may have the clear opening reduced to 20in (510mm) minimum.

Florida Children's Standards (3.14.5 Width)
Accessible doors shall have a minimum width of 36in.

Maneuvering Clearances

UFAS (4.13.6 Maneuvering Clearances at Doors)
Minimum maneuvering clearances at doors that are not automatic or power-assisted shall be as shown in Fig. 25. The floor or ground area within the required clearances shall be level and clear. Entry doors to acute care hospital bedrooms for in-patients shall be exempted from the requirement for space at the latch side of the door (see dimension "x" in Fig. 25) if the door is at least 44in (1120mm) wide.

Florida Children's Standards (3.14.5 Maneuvering Clearances)
All doors that are not automatic shall have a level clear space on each side of the door. The minimum length on the side into which the door opens (the pull side) shall be 60in. The minimum on the other side (push side) shall be 48in. The minimum width of this clear space (in targeted facilities) shall be the width of the door plus 18in on the latch side of the door. (Fig. 3.13, pg. 41.)

Guidelines:
Whenever possible, the full width should be the width of the door plus 24in for easier opening for those in larger electric wheelchairs, gurneys, etc.

Two Doors In a Series

UFAS (4.13.7 Two Doors In Series)
The minimum space between two hinged or pivoted doors in series shall be 48in (1220mm) plus the width of any door swinging into the space. Doors in series shall swing either in the same direction or away from the space between the doors (see Fig. 26).

Florida Children's Standards (3.14.7 Two Doors In a Series)
Minimum space between two doors shall be 48in plus the full width of any door(s) that swing into the vestibule space. (Fig. 3.14, pg. 42.)

Doors shall swing in the direction of exit.

Thresholds

UFAS (4.13.8 Thresholds at Doorways)
Thresholds at doorways shall not exceed 3/4in (19mm) in height for exterior sliding doors or 1/2in (13mm) for other types of doors. Raised thresholds and floor level changes at accessible doorways shall be beveled with a slope no greater than 1:2 (see 4.5.2).

Florida Children's Standards (3.14.8 Thresholds)
Thresholds shall not exceed 1/2in in height. Thresholds and other floor level changes (including change of materials) at accessible entrances shall be beveled with a slope of no greater than 1:2.

Door Hardware

UFAS (4.13.9 Door Hardware)
Handles, pulls, latches, locks and other operating devices on accessible doors shall have a shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist to operate. Lever-operated mechanisms, push-type mechanisms, and U-shaped handles are acceptable designs. When sliding doors are fully open, operating hardware shall be exposed and usable from both sides. In dwelling units, only doors at accessible entrances to the unit itself shall comply with the requirements of this paragraph. Doors to hazardous areas shall have hardware complying with 4.29.3. Mount no hardware required for accessible door passage higher than 48in (1220mm) above finished floor.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.13. Doors. All Provisions apply with the following addition.

4.13.9 Door Hardware is supplemented by: Hardware required for accessible door passage to be used by children shall be mounted no higher than 36 in (915mm) above the finished floor.

Florida Children's Standards (3.14.9 Door Hardware)
Handles, latches, levers and all operating devices on accessible doors shall be lever-operated mechanisms, push-bars, and U-shaped handles that have a shape which is easy to grasp or push with one hand an does not require tight grasping or twisting of the wrist to operate. They shall be mounted in the range of 30in to 34in above the floor.

North Carolina Code
Actuating mechanisms and door pulls shall be operable at a height not more than 30in above the finished floor or ground level. North Carolina Building Code Appendix A-8, Ref. 4.3.9 (a) (4), pg. 223.

Door Closers

UFAS (4.13.10 Doors - Closers)
If a door has a closer, then the sweep period of the closer shall be adjusted so that from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3in (75mm) from the latch, measured to the leading edge of the door.

Florida Children's Standards (3.14.10 Door Closers)
If door closers are used, the sweep period shall be adjusted so that from an open position of 90 degrees, the door takes a minimum of 20 seconds to move to an open position of approximately 12 degrees.

Door Opening Force

UFAS (4.13.11 Door Opening Force)
The maximum force for pushing or pulling open a door shall be as follows: (1) Fire doors shall have the minimum opening force allowable by the appropriate administrative authority. (2) Other doors. (a) exterior hinged doors: (Reserved). (b) interior hinged doors: 5 lbf (22.2N) (c) sliding or folding doors: 5 lbf (22.2N) These forces do not apply to the force required to retract latch bolts or disengage other devices that may hold the door in a closed position.

Florida Children's Standards (3.14.11 Door Opening Force)
(1) All fire doors shall conform to the minimum allowable force of the fire code currently in effect.

(2) All other accessible doors shall have a maximum force of 5 foot pounds.

Automatic Doors, Power-Assisted and Low-Energy Power-Operated Doors

UFAS (4.13.12 Automatic Doors and Power-Assisted Doors)
If an automatic door is used, then it shall comply with American National Standard for Power-Operated Doors, ANSI A156.10-1979. Slowly opening, low-powered, automatic doors shall be considered a type of custom design installation as described in paragraph 1.1.1 of ANSI A156.10-1979. Such doors shall not open to back check faster than 3 seconds and shall require no more than 15 lbf (66.6N) to stop door movement. If a power-assisted door is used, its door-opening force shall comply with 4.13.11 and its closing shall conform to the requirements in section 10 of ANSI A156.10-1979.

Florida Children's Standards (3.14.12 Automatic Doors)
If automatic doors are used, they shall comply with ANSI/BHMA A156.10 - 1985.

Florida Children's Standards (3.14.13 Power-assisted Doors and Low-energy Power-operated Doors)
Power-assisted doors shall comply with ANSI/BHMA A156.19 - 1984. Such doors shall not open to back check faster than 3 seconds and shall require no more than 15 foot pounds (66.6 Newton) to stop door movement.

Vision Panels

Florida Children's Standards (4.14.14 Vision Panels)
If vision panels are provided, then they shall be adjacent to the handle. The bottom of the vision panel shall begin at 30" from the floor and shall have a minimum area of 96 square inches.

Guidelines:
The minimum width of the panel should be 6".

Kickplates

Florida Children's Standards (3.14.15 Kickplates)
All doors shall have kickplates extending 18" above the floor and shall be made of a material such as metal or plastic laminates that can withstand battering from wheelchair footrests, crutches, and other ambulatory aids.

Drainage of Exterior Routes and Spaces

General

UFAS (4.8.8 Outdoor Conditions)
Outdoor ramps and their approaches shall be designed so that water will not accumulate on walking surfaces.

UFAS (4.9.6 Outdoor Conditions)
Outdoor stairs and their approaches shall be designed so that water will not accumulate on walking surfaces.

Florida Children's Standards (3.16.2 Stormwater Flow Across Accessible Routes and Spaces)
(1) No stormwater run-off from gutters or swales shall cross accessible routes or spaces along their surfaces or be deposited upon their surface. Subsurface conveyance or retention/detention must be used.

(2) There shall be no standing water from rain, accumulated stormwater run-off, or irrigation in accessible routes, ramp systems, landings, drop-off and loading zones, gathering areas, accessible parking, or waiting areas.

(3) Maximum cross-slope for drainage shall be 2%. Minimum cross-slope shall be 1%.

Curbs/Curb Ramps

Summary

Table 7 (following page) summarizes the quantitative requirements for various aspects of curb ramps (for children) as specified by the eight sources plus the UFAS.

Table 7
Curb Ramps

UFAS References	UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.7.1 When Used	any drop > 1/2"		any drop > 1/2"							
4.7.7 Warning Strips			12"min depth							beyond sides and beginning
4.7.3 Minimum Width	36"		36"							exclusive of flared sides
4.7.2 Transitions	flush									
4.7.2 Maximum Slope - Adjacent Surfaces	1:20		1:20							
4.7.5 Flared Sides	max 1:10		1:10							returned curbs if no pedestrians
4.7.7 Visual and Tactile Warnings	reserved		yes							surface material and color change required for ramp and flares
Clear Space in Front	36" min		36" to 48" min*							*48" for certain diagonal ramps

Comments related to Table 7

The only significant difference for curb ramps concern visual and tactile warnings. Florida requires a surface material change and color change for the ramped and flared sections.

Background Specifications for Curbs/Curb Ramps

Location and Placement

UFAS (4.7.1 Location)
Curb ramps complying with 4.7 shall be provided wherever an accessible route crosses a curb.

Florida Children's Standards (3.17.2 Location and Placement)
(1) Curb ramps shall be provided wherever any accessible route crosses a curb or vertical drop of more than 1/2in.

(2) The number of curb ramps occurring within any accessible route shall be kept to a minimum.

(3) If the curb ramp is located in the accessible route so that pedestrians must go across the ramp, with no plantings or other non-walking surfaces adjacent to the ramp, the dimensions of the curb ramp shall not intrude into the minimum clear width of the accessible route.

(4) Access to and from the curb ramp shall not be obstructed by parked cars, utility structures, signage, or any other obstructions.

(5) Curb ramps shall not extend into the lower level of the paved surface.

(6) The clear accessible width of curb ramps at marked crossings shall be entirely within the marked crossing. Flared sides may be excluded (Figure 3.16)

(7) At passenger drop-off and loading zones, transit must be accomplished with a continuous 1:12 curb ramp that extends the full length of the drop-off and loading zone, with markings in color and texture to serve as visual and tactile warnings. The warning strip shall be a minimum of 12in beyond the sides and beginning of the ramp.

Location at Marked Crossings

UFAS (4.7.9 Location at Marked Crossings)
Curb ramps at marked crossings shall be wholly contained within the markings, excluding any flared sides (see Fig. 15).

Florida Children's Standards (3.17.2 Location and Placement)
(6) The clear accessible width of curb ramps at marked crossings shall be entirely within the marked crossing. Flared sides may be excluded (Figure 3.16)

Width of Curb Ramps

UFAS (4.7.3 Width)
Minimum width of a curb ramp shall be 36in (915mm), exclusive of flared sides.

Florida Children's Standards (3.17.3 Width of Curb Ramps)
Minimum width of a curb ramp shall be 36in exclusive of any side ramps or flared sides.

Slopes

UFAS (4.7.2 Slope)
Slopes of curb ramps shall comply with 4.8.2. The slope shall be measured as shown in Fig. 11. Transitions from ramps to walks, gutters or streets shall be flush and free of abrupt changes. Maximum slopes of adjoining gutters, road surface immediately adjacent to the curb ramp, or accessible route shall not exceed 1:20.

Florida Children's Standards (3.17.4 Slopes)
(1) Curb rams shall have a maximum slope of 1:12.

(2) Maximum counterslopes of adjoining surfaces, including gutters shall not exceed 1:20. (Fig. 3.17, pg. 48.)

Side Configurations of Curb Ramps

UFAS (4.7.5 Sides of Curb Ramps)
If a curb ramp is located where pedestrians must walk across the ramp, or where it is not protected by handrails or guardrails, then it shall have flared sides: the maximum slope of the flare shall be 1:10 (see Fig. 12 (a)). Curb ramps with returned curbs may be used where pedestrians would not normally walk across the ramp (see Fig. 12 (b)).

Florida Children's Standards (3.17.5 Side Configurations of Curb Ramps)

(1) If a curb ramp is located where pedestrians must walk across it, it shall have flared sides with a maximum slope of 1:10. (Fig. 3.18, pg. 50.)

(2) Returned curbs shall be used only where pedestrians will not normally walk across the curb ramp, such as when the ramp length is surrounded by planting or other non-walking surfaces, or there are physical elements such as signage or vertical posts that prevent circulation over that portion of the paved surface. (Fig. 3.19, pg. 50.)

Surfaces and Finishes

UFAS (4.7.4 Surface)

Surfaces of curb ramps shall comply with 4.5.

Warning Treatments

UFAS (4.7.7 Warning Textures)

(Removed and reserved).

Florida Children's Standards (3.17.7 Warning Treatments)

(1) If the curb ramp is located in paving or hard surface, and there are no physical barriers such as railings or walls to help define the curb ramp, then changes in paving material and color as well as texture for the entire ramp (including flares) shall serve as a detectable warning.

(2) If the curb ramp is not located with accessible paving immediately adjacent to its sides, then a detectable warning strip of at least a change in texture shall extend the full width and depth of the curb ramp.

Guidelines:

For the visually impaired, and for large numbers of small children moving at one time texture may not be enough to warn of a change in surface slopes. Many ambulatory disabled walk with a shuffle and may become unbalanced if they come upon a curb ramp unexpectedly. Therefore, textural warning strips are not acceptable. In fact, based upon the placement and amount of traffic experienced by or near individual curb ramps, the extent of warning treatment may need to extend beyond the curb ramp itself. Or the designer may chose to use alternative treatments.

Research into perceptions of the visually impaired gives several recommended treatments:

Changes from brushed concrete to thermoplastic strips, nicked concrete, exposed pea gravel aggregate, and pliant polymer were distinguished by more than 85% of totally blind people surveyed.

Changes from brushed concrete to mortared brick paving, solid thermoplastic, Kushioncore, and scored concrete were distinguished by 70-80%.

Changes from brushed concrete to asphalt or burlap-textured concrete were detected by fewer than 70%.

[Source: John Temple, "Provisions for Elderly and Handicapped Pedestrians". Federal Highway Administration Report no. FHwA-RD-79, 1980.]

Diagonal Curb Ramps

UFAS (4.7.10 Diagonal Curb Ramps)

If diagonal (or corner type) curb ramps have returned curbs or other well-defined edges, such edges shall be parallel to the direction of pedestrian flow. The bottom of diagonal curb ramps shall have 48in (1220mm) minimum clear space as shown in Fig. 15 (c) and (d). If diagonal curb ramps are provided at marked crossings, the 48in (1220mm) clear space shall be within the markings (see Fig. 15 (c) and (d)). If diagonal curb ramps have flared sides, they shall also have at least a 24in (610mm) long segment of straight curb located on each side of the curb ramp and within the marked crossing (see Fig. 15 (c)).

Florida Children's Standards (3.17.8 Diagonal Curb Ramps)

(1) If diagonal or corner type curb ramps have returned curbs or other well-defined edges, the edges shall be parallel to the main flow of pedestrian traffic. At the walk level of the curb ramp, there should be a minimum clear width of 48in (Figure 3.20).

(2) diagonal curbs with flared sides shall have a minimum 48 inch clear width of accessible route between flares. (Figure 3.21)

(3) If diagonal curbs are used at marked intersections, the clear width of the accessible route shall be within the markings. (Figure 3.20 and Figure 3.21)

Islands

UFAS (4.7.11 Islands)
Any raised islands in crossings shall be cut through level with the street or have curb ramps at both sides and a level area at least 48in (1220mm) long in the part of the island intersected by the crossings (see Fig. 15 (a) and (b)).

Florida Children's Standards (3.17.9 Islands)
Any raised islands shall continue the accessible route through at the level of the street or, if a large island, it shall have a level area of a minimum of 5 feet between the curb ramps.

Uncurbed Intersections

UFAS (4.7.12 Uncurbed Intersections)
(Removed and reserved).

Florida Children's Standards (3.17.10 Uncurbed Intersections)
If there is no curb at the intersection of a walk and the adjoining street, parking, or driveway, the walk shall have a detectable warning strip employing differences in color and/or material as well as texture. Minimum width of the warning strip shall be 36in. Guardrails or other physical barriers may be used to separate pedestrian and vehicular traffic immediately adjacent to the intersection.

Built-up Curb Ramps

UFAS (4.7.6 Built-up Curb Ramps)
Built-up curb ramps shall be located so that they do not project into vehicular traffic lanes(see Fig. 13).

Obstructions

UFAS (4.7.8 Obstructions)
Curb ramps shall be located or protected to prevent their obstruction by parked vehicles.

Protruding Objects

Summary

Table 8 (following page) summarizes the quantitative requirements for various aspects of protruding objects (for children) as specified by the eight sources plus the UFAS.

Table 8
Protruding Objects

UFAS References	UFAS	ATBCE Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.4.1 Objects 27" - 80" AFF	4" max		4"max 12"- 80" AFF							cannot reduce accessible route width
4.4.1 Objects < 27" AFF	no limit		no limit ≤12" AFF							cannot reduce accessible route width
4.4.1 Objects on Posts 27" - 80' AFF	12" max		12"max							cannot reduce accessible route width
4.4.2 Head Room	80" min		96"							< 80" requires barrier

Comments related to Table 8

Florida extends the lower limit for protruding objects to 12in above the floor. The standard suggests that young children using a cane to detect objects may have difficulty recognizing objects above 12in above the floor.

Headroom is also increased to 96in from 80in (UFAS) in the Florida guidelines.

Background Specifications for Protruding Objects

General

UFAS (4.4.1 General)
Objects protruding from walls (for example, telephones) with their leading edges between 27in and 80in (685mm and 2030mm) above the finished floor shall protrude no more than 4in (100mm) into walks, halls, corridors, passageways, or aisles (see Fig. 8 (a)). Objects mounted with leading edges at or below 27in (685mm) above the finished floor may protrude any amount (see Fig. 8 (a) and (b)). Free-standing objects mounted on posts or pylons may overhang 12in (305mm) maximum from 27in to 80in (685mm to 2030mm) above the ground or finished floor (see Fig. 8 (c) and (d)). Protruding objects shall not reduce the clear width of an accessible route or maneuvering space (see Fig. 8 (e)).

Florida Children's Standards (3.19.1 General)
Objects protruding from walls (for example, telephones) with their leading edges between 12inand 80in above the finished floor shall protrude no more than 4in into walks, halls, corridors, passageways, or aisles (Figure. 3.22, pg. 53). Objects mounted with leading edges less than or equal to 12in above the floor may protrude any amount (Figures. 3.23 and 3.24, pgs. 53,54). Free-standing objects mounted on posts or pylons may overhang 12in maximum from 12in - 80in above the ground or finished floor. (Figures 3.25, 3.26, 3.27, 3.28, and 3.29) Protruding objects shall not reduce the width of an accessible route or maneuvering space (Figure 3.30, pg. 56).

Headroom

UFAS (4.4.2 Head Room)
Walks, halls, corridors, passageways, aisles, or other circulation spaces shall have 80in (2030mm) minimum clear head room (see Fig. 8 (a)). If vertical clearance of an area adjoining an accessible

route is reduced to less than 80in (nominal dimension), a barrier to warn blind or visually-impaired persons shall be provided (see Fig. 8 (c)).

Florida Children's Standards
Walks, halls , passageways, aisles or other circulation spaces shall have 96 inches minimum clear headroom. (Figure 3.22) Exit corridors shall be a minimum of 108in in height. If vertical clearance of an area adjoining an accessible route is reduced to less than 80in nominal dimension, a guardrail or other barrier having its leading edge at or below 12in above the finished floor shall be provided. (Figure 3.29)

Signage

Summary

Table 9 (following page) summarizes the quantitative requirements for various aspects of signage (for children) as specified by the eight sources plus the UFAS.

Table 9
Signage

UFAS Reference	UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.30.2 Width to Height Ratio	3:5 - 1:1		3:5 - 1:1							
4.30.2 Stroke Width to Height	1:5 - 1:8		1:5 - 1:10							
4.30.4 Tactile Characters	Raised or Incised *		Raised only							
4.30.4 Raised/Incised Depth	1/32" min		1/32" min							Pictographs also
4.30.6 Size - Height	5/8" - 2"		5/8" - 2"							
4.30.6 Mounting Height	54" - 66"	40" max	42" max		40" max					Latch side of door

* Incised requires minimum stroke width 1/4".

Comments related to Table 9

Florida guidelines parallel the UFAS requirements with several exceptions. Florida does not permit the use of incised letters (similar to ANSI A117.1(1986)), the mounting height for letters is lower (42in max.) and the width to height ratio is slightly different.

The only other sources for this topic covered mounting height and these used the same maximum height of 40in.

Background Specifications for Signage

General

UFAS (4.30.5 Symbols of Accessibility)
Accessible facilities required to be identified by 4.1 shall use the international symbol of accessibility. The symbol shall be displayed as shown in Fig. 43.

Character Proportion

UFAS (4.30.2 Character Proportion)
Letters and numbers on signs shall have a width-to-height ratio between 3:5 and 1:1 and a stroke width-to-height ration between 1:5 and 1:10.

Florida Children's Standards (3.20.2 Character Proportion)
Letters and numbers on signs shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:8, utilizing an upper-case "X" for measurement.

> Guidelines:
> The legibility of signage is a function of viewing distance, letter height, spacing between letters, contrast between lettering and background and type of font. The most legible typefaces have been found to be sans serif typefaces or a simple serif typeface.

Color Contrast

UFAS (4.30.3 Color Contrast)
Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

Florida Children's Standards (3.20.3 Color Contrast)
Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

Guidelines:
Readability is a product of contrast between light and dark values. Two different colors of the same value or pastels in the same range are not very effective.

Tactile Characters or Symbols

UFAS (4.30.4 Raised or Indented Characters or Symbols)
Letters and numbers on signs shall be raised or incised 1/32in (0.8mm) minimum and shall be sans serif characters. Raised characters or symbols shall be at least 5/8in (16mm) high, but no higher than 2in (50mm). Indented characters or symbols shall have a stroke width of at least 1/4in (6 m). Symbols or pictographs on signs shall be raised or indented 1/32in (0.8mm) minimum.

Florida Children's Standards (3.20.4 Tactile Characters or Symbols)
Characters, symbols, or pictographs on tactile signs shall be raised 1/32in minimum. Raised letters and numbers shall be sans serif uppercase characters. Raised characters or symbols shall be at least 5/8in high, but no higher than a nominal 2in.

Guidelines:
Braille signage may not be effective. It is readable by only a small portion of the population and not at all by small children who do not have reading skills.

Mounting Location and Height

UFAS (4.30.6 Mounting Location and Height)
Interior signage shall be located alongside the door on the latch side and shall be mounted at a height of between 54in and 66in (1370mm and 1675mm) above the finished floor.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.30.6 Signage - Mounting Height. All provisions apply with the following addition:
Signs for use by children shall be mounted at a height no higher than 40 in (1015mm) above the floor.

Florida Children's Standards (3.20.5 Mounting Location and Height)
Interior signage shall be located alongside the door on the latch side and shall be mounted at a maximum height of 42in above the finished floor. (Fig. 3.31, pg. 59.)

North Carolina Code
Plaques or signs shall be mounted with the top of the identifying device no higher than 40in above the finished floor. Appendix A-16, Ref. 4.11 (c) (1), pg. 231. For offices, classrooms, gymnasiums, etc. signage is to be located on the same side of the wall as door hardware. For areas where the door is closed but not locked, such as restrooms, signage is to be located on the door itself.

Detectable Warnings

General

UFAS (4.29.1 General)
Tactile warnings required to be accessible by 4.1 shall comply with 4.29.

Detectable Warnings on Walking Surfaces

UFAS (4.29.2 Tactile Warnings on Walking Surfaces)
(Reserved).

Florida Children's Standards (3.21.2 Detectable Warnings on Walking Surfaces)
Detectable warning textures on walking surfaces shall consist of exposed aggregate concrete, cushioned surfaces made of rubber or plastic, raised strips, grooves, or similar materials. Textures shall contrast, visually and tactilely, with that of the surrounding surface. Raised strips or grooves shall comply with Fig. 3.32, pg. 60. Grooves on the exterior shall provide for water drainage.

Tactile Warnings on Doors to Hazardous Areas

UFAS (4.29.3 Tactile Warnings on Doors to Hazardous Areas)
Doors that lead to areas that might prove dangerous to a blind person (for example, doors to loading platforms, boiler rooms, stages, and the like) shall be made identifiable to the touch by a textured surface on the door handle, knob, pull, or other operating hardware. This textured surface may be made by knurling or roughing or by a material applied to the contact surface. Such textured surfaces shall not be provided for emergency exit doors or any doors other than those to hazardous areas.

Florida Children's Standards (3.21.3 Tactile Warnings on Doors to Hazardous Areas)
Doors that lead to areas that might prove dangerous to a blind person (for example, doors to loading platforms, boiler rooms, stages, and the like) shall be made identifiable to the touch by a textured surface on the door handle, knob, pull, or other operating hardware. This textured surface may be made by knurling or roughing or by a material applied to the contact surface. Such textured surfaces shall not be provided for emergency exit doors or any doors other than those to hazardous areas.

Detectable Warnings at Reflecting Pools

Florida Children's Standards (3.21.4 Detectable Warnings at Reflecting Pools)
The edges of reflecting pools shall be protected by railings, walls, curbs, or detectable warnings complying with the Section 3.21.2. (editors note: the following materials comply with 3.21.2: exposed aggregate concrete, cushioned surfaces made of rubber or plastic, raised strips, grooves, or similar materials.)

Standardization

UFAS (4.29.7 Standardization)
Textured surfaces for tactile door warnings shall be standard within a building, facility, site or complex of buildings.

Florida Children's Standards
Textured surfaces for tactile door warnings shall be standard within a building, facility, site or complex of buildings.

Parking

Summary

Table 10 (following page) summarizes the quantitative requirements for various aspects of parking (for children) as specified by the eight sources plus the UFAS.

Table 10
Parking Spaces

	UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.6.3 Width of Space	96" min		144" min							
4.6.3 Adjacent Access Aisle	60" min *									
4.6.3 Maximum Slope (any direction)	1:50									
4.6.6 Vertical Clearances	114" min**		180" min							

* Adjacent access aisles for vans 96".

** Height required for vans only not all spaces

Comments related to Table 10

Only one provision differs from the UFAS specification and that covers the width of the parking space. Florida does not specify an access aisle plus a regular parking space but instead specifies a 144in wide minimum parking space. This width is less than the width of the UFAS space (96in plus a 60in min width access aisle).

Background Specifications for Parking

General

UFAS (4.6.1 Minimum Number)
Parking spaces required to be accessible by 4.1 shall comply with 4.6.2 through 4.6.4. Passenger loading zones required to be accessible by 4.1 shall comply with 4.6.5 and 4.6.6.

Location and Placement

UFAS (4.6.2 Location)
Parking spaces for disabled people and accessible passenger loading zones that serve a particular building shall be the spaces or zones located closest to the nearest accessible entrance on an accessible route. In separate parking structures or lots that do not serve a particular building, parking spaces for disabled people shall be located on the shortest possible circulation route to an accessible pedestrian entrance of the parking facility.

Florida Children's Standards (4.1.2 Location and Placement)
(1) Designated handicapped parking spaces shall be located as close as possible to the accessible entrance(s) and facilities they serve.

(2) Handicapped parking spaces shall not be placed so that pedestrians must cross vehicular traffic in reaching the accessible route.

(3) All specifically designated handicapped parking spaces shall be identified as "reserved for handicapped use only" by signage. Such signs shall not be obscured by vehicles, plantings, or other elements. Spaces may be additionally designated as reserved by painted symbols on the paving and/or a different color of paint for the striping of spaces.

Width of Parking Spaces

UFAS (4.6.3 Parking Spaces)

Parking spaces shall be at least 96" (2440 mm) wide and shall have an adjacent access aisle 60" (1525 mm) wide minimum (see Fig. 9). Parking access aisles shall be part of an accessible route to the building or facility entrance and shall comply with 4.3. Two accessible parking spaces may share a common access aisle. Parked vehicle overhangs shall not reduce the clear width of an accessible circulation route. Parking spaces and access aisles shall be level with surface slopes not exceeding 1:50 in all directions.

EXCEPTION: If accessible parking spaces for vans designed for handicapped persons are provided, each should have an adjacent access aisle at least 96" (2440 mm) wide and complying with 4.5, Ground and Floor Surfaces.

Florida Children's Standards (4.1.4 Width of Parking Spaces)

Parking spaces designated for the physically handicapped shall be minimum of 12' wide (Fig. 4.1, pg. 62).

Signage

UFAS (4.6.4 Signage)

Accessible parking spaces shall be designated as reserved for the disabled by a sign showing the symbol of accessibility (see 4.30.5). Such signs shall not be obscured by a vehicle parked in the space.

Vertical Clearances

UFAS (4.6.6 Vertical Clearance)

Provide minimum vertical clearances of 114in at accessible passenger loading zones and along vehicle access routes to such areas from site entrances. If accessible van parking spaces are provided, then the minimum vertical clearance should be 114in.

Passenger Drop-off and Loading Zones

Summary

Table 11 summarizes the quantitative requirements for various aspects of drop-off and loading zones (for children) as specified by the eight sources plus the UFAS.

Table 11
Drop-Off and Loading Zones

UFAS	Reference	UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.6.5	Access Aisle	5' X 20'	12' X 50'	12' X 60' *							
	Drop-Off to Building			100' **							

* If separate 12' X 60' space is not possible, a 48"loading access aisle shall be provided between parked vehicles and the accessible rout

** Covered rest areas are required if 100' must be exceeded.

Comments related to Table 11

Both the ATBCB supplement and the Florida guidelines pertain to elementary schools which probably accounts for the larger size for the access aisle as compared to the UFAS. Florida also specifies rest areas every 100 feet.

No state codes had any special provisions for drop-off and loading zones that pertain to children.

Background Specifications for Drop-Off and Loading Zones

General

UFAS (4.6.1 Minimum Number)
Parking spaces required to be accessible by 4.1 shall comply with 4.6.2 through 4.6.4. Passenger loading zones required to be accessible by 4.1 shall comply with 4.6.5 and 4.6.6.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.6.5 is supplemented by: Loading zones shall be protected from the weather, if necessary. The zones should be 12 ft (4 m) wide by 50 ft (15 m) long to accommodate buses and vans.

Florida Children's Standards (4.3.1 General)
All educational facilities subject to this code shall have at least one major entrance served by a passenger drop-off and loading zone that complies with the standards of this section. The preferred situation is that of one main entrance used by everyone. Exemptions may include the adaptive reuse of historic structures if an accessible drop-off and loading zone is available at another easily accessible and well-identified secondary entrance.

Location and Placement

Florida Children's Standards (4.3.2 Location and Placement)
(1) Drop-off and loading zones shall be as close to the accessible entrance(s) and facilities as possible. The accessible route shall be the shortest distance possible from the drop-off and loading zone to the accessible entrance. Maximum distance of the accessible route from drop-off and loading zone to the building entrance shall be 100 feet.

(2) If it is impossible to comply with this standard of 100 feet maximum distance for all entrances and facilities within the school plant, covered rest areas shall be provided at the drop-off and loading zone itself and at the building entrance.

(3) At least one entrance and/or loading zone per school shall meet the minimum standards set forth in section Section 4.3, Passenger Drop-off and Loading Zones, for regular class day arrivals and departures. If the gymnasium or auditorium (or any other facility used before or after regular school hours) are served by a separate entrance and/or drop-off and loading zone, they must also meet these standards.

(4) The preferred solution is that of barrier-free entrance(s) and loading zone(s) that are used equally by everyone, able or disabled, instead of separate or distinct handicapped accessible entries and loading zones.

(5) Signage shall identify the drop-off and loading zone and limit its use to that function.

Passenger Loading and Drop-off Aisles

UFAS (4.6.5 Passenger Loading Zones)

Passenger loading zones shall provide an access aisle at least 60" (1525 mm) wide and 20' (6 m) long adjacent and parallel to the vehicle pull-up space (see Fig. 10). If there are curbs between the access aisle and vehicle pull-up space, then a curb ramp complying with 4.7 shall be provided. Vehicle standing spaces and access aisles shall be level with surface slopes not exceeding 1:50 in all directions.

Florida Children's Standards (4.3.3 Passenger Loading and Drop-off Aisles)

(1) A distinct drop-off aisle shall be separate from the main flow of continuous vehicular traffic. It shall allow the car or bus to park and discharge children without blocking traffic and without forcing children to cross traffic to reach the accessible route to the building entry.

(2) The preferred solution is a distinct drop-off aisle that is completely separate from the main flow of traffic. Minimum width shall be 12 feet. Minimum length shall be 60 feet.

If impossible to comply with the above standard because of site constraints, a loading access aisle of a minimum of 48" in width shall be provided between the parked vehicle and the accessible route in place of a separate and distinct drop-off aisle.

(3) The clear minimum width of the accessible route shall not be infringed upon by any drop-off or loading aisles, waiting areas, or vehicular circulation.

Florida Children's Standards (4.3.4 Climatic protection) (1) Children shall be protected from rain and sun, from the building entrance to the door of the vehicle in the drop-off and loading zone, by continuous covered walkways and covered waiting areas. Any overhead structure that has openings, such as a trellis, is not acceptable. This is in addition to the requirements of Section 3.13.2, Climatic Protection.

(2) The preferred situation is that as many buses and cars as possible be protected at one time by a solid overhead structure. The protective cover shall extend the length of the loading area. The covered protection directly over waiting cars and/or buses shall be a minimum of 20 feet in length and extend a minimum of 6 feet over the stopped vehicle's drop-off lane or aisle. Minimum clear vertical clearance between the vehicular paving and the underside of the cover shall be 15 feet.

Auditorium and Assembly Areas

Summary

Table 12 summarizes the quantitative requirements for various aspects of seating (for children) as specified by the eight sources plus the UFAS.

Table 12: Auditorium and Assembly Areas

Table 12
Seating

UFAS Reference		UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.2.4.1	Clear Floor Space for Wheelchairs	30" X 48" min		(Forward) 33" X 48"min (Side) 33" X 60"min							
	Between Seats			18" - 24" min							Clear floor space for children who use braces and crutches or cannot bend legs
4.32.2	Table to Wall Distance	36" min		42" min*							Auditorium seating
4.33.3	Placement of Wheelchair Seating	Dispersed		Dispersed							Exceptions noted
4.2.1	Clear access aisle	36" min		44" min**							**Libraries & Media Ctrs.
4.33.6	Listening Systems	Max 50' from stage		Max 50' from stage							

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Comments related to Table 12

Florida provides the only guidelines for this topic that are specific to children. Several provisions differ from UFAS and two are not covered by UFAS. The clear floor space required by Florida is wider than that specified by UFAS (33 in vs 30 in min).

The distance between fixed seats (e.g. auditorium seating) is specified as 18 in-24 in so that children who cannot bend their legs can sit down. The Florida guidelines also specify a 42 in min space be provided between the table and wall (or seat etc.) presumably to permit a child using a wheelchair to turn 90 degrees and pull under the table.

Background Specifications for Auditorium and Assembly Areas

Minimum Number of Wheelchair Spaces

UFAS (4.33.1 Minimum Number)

Assembly and associated areas required to be accessible by 4.1 shall comply with 4.33.

shall comply with the following table:

Total Seating Capacity	*# Wheelchair Spaces Required*
50-75	*3*
76-100	*4*
101-150	*5*
151-200	*6*
201-300	*7*
301-400	*8*
401-500	*9*
501-1000	*2% of total*
over 1,000	*20 plus 1 for each 100 over 1,000*

Florida Children's Standards (Minimum Number of Wheelchair Spaces)

Assembly areas shall comply with the following table:

(1)

Capacity of Seating And Assembly Areas	Number of Required Wheelchair Spaces
50-75	3
76-100	4
101-150	5
151-200	6
201-300	7
301-400	8
401-500	9
501-1000	2% of total

The same percentage of seating shall be designed to provide for children with crutches and walkers as is required for wheelchairs.

(2) Auditoriums shall have a listening system to assist the programmed number of hearing impaired people, but no fewer than five head set connections.

Guidelines:

Seating for children with braces can occur on cross aisles to meet the dimensional criteria; however, the aisleway may need to be increased so circulation is not impeded. Targeted facilities will have a higher percentage of children in wheelchairs and will require a greater number of appropriate spaces. Areas designed for two wheelchairs allows friends to sit together.

Dimensions of Handicapped Seating

UFAS (4.33.2 Size of Wheelchair Locations)
Each wheelchair location shall provide minimum clear ground or floor spaces as shown in Fig. 46.

Florida Children's Standards (Dimensions for Handicapped Seating)
Handicapped seating shall use the following criteria:

(1) Each wheelchair location shall provide minimum clear ground or floor spaces as shown in Fig. 5.1, pg. 70.

(2) Seating for children with braces or crutches shall provide a minimum clearance of 18 in - 24 in as shown in Fig. 5.2.

(3) For situations that include fixed tables, a minimum clearance of 42 in shall be provided behind the table and the next adjacent table or wall as indicated Fig. 5.3, pg. 72.

Placement of Handicapped Seating

UFAS (4.33.3 Placement of Wheelchair Locations)
Wheelchair areas shall be an integral part of any fixed seating plan and shall be dispersed throughout the seating area. They shall adjoin an accessible route that also serves as a means of egress in case of emergency and shall be located to provide lines of sight comparable to those for all viewing areas.

EXCEPTION: Accessible viewing positions may be clustered for bleachers, balconies, and other areas having sight lines that require slopes of greater than 5 percent. Equivalent accessible viewing positions may be located on levels having accessible egress.

Florida Children's Standards (5.1.4 Placement of Handicapped Seating)
Wheelchair areas shall be an integral part of any fixed seating plan and shall be dispersed throughout the seating area. They shall adjoin an accessible route that also serves as a means of egress in case of emergency and shall be located to provide lines of sight comparable to those for all viewing areas.

> **Guidelines:**
>
> **Attention should be given to potential disruption of sight lines by wheelchairs for regular seating. Seating close to the stage is needed for those children who use braces or wheelchairs or are visually impaired.**

Surfaces

UFAS (4.33.4 Surfaces)
The ground or floor at wheelchair locations shall be level and shall comply with 4.5.

Access to Performing Areas

UFAS (4.33.5 Access to Performing Areas)
An accessible route shall connect wheelchair seating locations with performing areas, including stages, arena floors, dressing rooms, locker rooms and other spaces used by the performers.

Florida Children's Standards (5.1.6 Access to Performing Areas)
An accessible route shall connect wheelchair seating locations with performing areas, including stages, arena floors, dressing rooms, locker rooms and other spaces used by the performers.

Placement of Listening Systems

UFAS (4.1.2.18 (b) Accessible Buildings - Assembly Areas)
Assembly areas with audio-amplification systems shall have a listening system complying with 4.33 to assist a reasonable number of people, but no fewer than two, with severe hearing loss. For assembly areas without amplification systems and for spaces used primarily as meeting and conference rooms, a permanently installed or portable listening system shall be provided. If portable systems are used for conference or meeting rooms, the system may serve more than one room.

UFAS (4.33.6 Placement of Listening Systems)
If the listening system provided serves individual fixed seats, then such seats shall be located within a 50ft (15 m) viewing distance of the stage or playing area and shall have a complete view of the stage or playing area.

Florida Children's Standards (5.1.7 Placement of Listening Systems)
If the listening system provided serves individual fixed seats, then such seats shall be located within a 50-foot viewing distance of the stage or playing area and shall have a complete view of the stage or playing area.

Types of Listening Systems

UFAS (4.33.7 Types of Listening Systems)
Audio loops and radio frequency systems are two acceptable types of listening systems.

Florida Children's Standards (5.1.8 Types of Listening Systems)
Induction loops, infrared systems, both FM and AM radio frequency systems, hardwired earphones, and other equivalent devices are among the acceptable types of listening systems.

Libraries and Media Centers

Summary

Table 13 summarizes the quantitative requirements for various aspects of libraries and media centers (for children) as specified by the eight sources plus the UFAS.

Table 13
Libraries and Media Centers

UFAS	Reference	UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
8.4	Card Catalogs - Clear Width	36"									
8.4	Card Catalogs - Reach forwarc AFF side AFF AFF	48" max 54" max 18" min	36" max			36" max 20" min					
8.5	Stacks - Clear Width	36" min 42" preferred									
8.5	Stacks - Height	unrestricted									

Comments related to Table 13

The ATBCB supplement and the North Carolina Code only cover the reach ranges permitted for card catalogs. Each has a maximum vertical reach of 36in (as compared to UFAS 54in) and North Carolina specifies a minimum height of 20in.

Background Specifications for Libraries and Media Centers

General

UFAS (8.1 General)
In addition to the requirements of 4.1 to 4.33 the design of all public areas of a library shall comply with 8, including reading and study areas, stacks, reference rooms, reserve areas, and special facilities or collections. As provided, elements such as public toilet rooms, telephones, and parking shall be accessible.

Reading and Study Areas

UFAS (8.2 Reading and Study Areas)
At least 5 percent or a minimum of one of each element of fixed seating, tables, or study carrels shall comply with 4.2 and 4.32. Clearances between fixed accessible tables and study carrels shall comply with 4.3.

Florida Children's Standards (5.2.2 Reading and Study Areas)
At least 5 percent or a minimum of one of each element of fixed seating, tables, or study carrels shall be provided for handicapped children.

Florida Children's Standards (5.2.3 Work Tables and Study Carrels)
Work surfaces shall meet the following criteria:

(1) Work surface heights shall be a maximum of 30 inches with a minimum arm rest clearance of 27 inches, 19 inches in depth, and 30 inches in width.

(2) A minimum clear aisle width of 44 inches shall be provided between fixed tables, carrels and seating.

Check-out Areas

UFAS (8.3 Check-Out Areas)
At least one lane at each check-out area shall comply with 4.32. Any traffic control or book security gates shall comply with 4.13.

Florida Children's Standards (5.2.4 Check-out Areas)
At least one lane at each check-out area shall provide a check-out counter with a maximum height of 30 inches. Any traffic control or book security gates shall provide a minimum aisle width of 44 inches.

Card Catalog, Computer Terminals and Reference Display

UFAS (8.4 Card Catalogs)
Minimum clear aisle space at card catalogs, magazine displays or reference stacks shall comply with Fig. 55. Maximum reach height shall comply with 4.2, with a height of 48in (1220mm) preferred, irrespective of reach allowed.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 8.4 (Libraries - Card Catalogs). All provisions apply with the following addition:
Minimum clear aisle space at card catalogs, magazine displays, dictionary stands, or reference stacks to be used by children shall comply with modified Figure 55 . Maximum reach height shall be 36 in (915mm).

Florida Children's Standards (5.2.5 Card Catalog, Computer Terminals, and Reference Display)
Card catalog and reference display areas shall meet the following criteria:

(1) A minimum clear aisle space of 36 inches shall be provided at card catalogs, magazine displays or dictionary stands. (Fig. 5.4)

(2) Maximum reach height of 36 inches shall be provided at card catalogs, magazine displays, or dictionary stands. (Fig. 5.4)

(3) Counter heights for computer terminals shall be a maximum height of 30 inches above finished floor.

Guidelines:

A minimum clear aisle space of 44 inches is preferred at card catalogs, magazine displays, or dictionary stands. All furniture hardware, such as pulls and handles, should be easily operable with one hand.

Targeted facilities will require a higher percentage of spaces for children in wheelchairs than required in Section 5.2.2, Reading and Study Areas.

Florida Children's Standards (5.2.6 Stacks)
A minimum clear aisle width of 36 inches shall be provided between stacks. (Fig. 5.4)

North Carolina Code
The base of the card catalog (or catalogs, if there are more than one) shall be a minimum of 20in above the finished floor. The finished top of the card catalog(s) shall be 36in above the finished floor. Ref. 7.4(c), pg. 233.

Stacks

UFAS (8.5 Stacks)
Minimum clear aisle width between stacks shall comply with 43, with a minimum clear aisle width of 42in (1065mm) preferred where possible. Shelf height in stack areas is unrestricted (see Fig. 56).

Classrooms and Instructional Areas

Summary

Table 14 summarizes the quantitative requirements for various aspects of classrooms and instructional areas (for children) as specified by the eight sources plus the UFAS.

Table 14
Classrooms and Instructional Areas

UFAS	Reference	UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
	Wall Mounted Objects AFF		36" max								
	Minimum Blackboard Height AFF		24" min								
	Floor Areas				750 - 1200 sq ft						< 1000 sq ft - max 3:2
	Lighting - Classrooms				60 - 70 ftcdls						Length to width ratio
	Lighting - Labs & Multipurpose Rooms				100 - 150 ftcdls						
	Tables & Work Surfaces - Width			30"							
4.32.4	Tables & Work Surfaces - Height	28" - 34"	30" max	25" - 30"		30" max					
4.32.3	Arm Rest Clearance AFF	27"	24"	27"		24"					Height of knee space
4.32.3	Knee Space - Depth	19"	19"	19"							
4.32.3	Knee Space - Width	30" min	30" min	36"min							

* Florida requires that at least one section of counter 36" in width be adjustable or replaceable with a height 25" to 30" AFF. Counter can also be fixed at 30".

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Comments related to Table 14

Florida mentions the need for tables with adjustable height surfaces although the guidelines permit fixed tables that can be repositioned as an alternative. The work surface heights specified for tables ranged from 25in to 30in for the children's provisions and from 28in to 34in for the UFAS.

The North Carolina Department of Education specifies minimum illumination levels for laboratories and classrooms although it is not known if these requirements are appropriate for children with visual disabilities.

Background Specifications for Classrooms and Instructional Areas

Basic Definitions and Components

ATBCB Children's Recommendations for Elementary Schools (1986)
Supplemental Recommendations
Accessible classrooms shall meet the requirements of UFAS 4.1 to 4.33 (Accessible Elements and Spaces: Scope and Technical Requirements), as supplemented by these recommendations, with the following addition: Wall mounted objects - objects such as pencil sharpeners, light switches, blackboards, etc., shall have the centerline mounted no higher than 36 in (915mm) maximum. The bottom edge of blackboards shall be no higher than 24 in (610mm) above the floor.

North Carolina Code
Programs for exceptional children vary greatly depending on local factors. Spaces must be planned to accommodate educational programs identified in educational specifications. The local factors often result in spaces which are larger than the minimum requirements. Programs serving exceptional children may also require cooking areas, toilets, bath/shower rooms, and laundries. If resource rooms used by exceptional children are clustered around a shared common area, they may be smaller than the standard for small group rooms (Floor Areas below). Minimum requirements for handicapped accessibility as outlined in the North Carolina Building Code may not be adequate for special education programs. At least one handicapped station within a row of regular seating will be provided in music rooms in accordance with the North Carolina Building Code.

Floor Areas

North Carolina Code
Grade K: 1200 sq ft, grades 1-3: 1000-1200, grades 4-6: 850-1000, grades 7-12: 750-850, computer classrooms for grades 4-12: 850-1000. For remediation and resource labs: 450. Minor reductions in size are allowable when architectural design and detailing require it. Classrooms smaller than 1000 sq ft should not exceed a 3:2 length to width ratio.

Environmental Technologies

Lighting - General

North Carolina Code
Lighting standard for regular classrooms, small group rooms, and rooms for exceptional children is 60-70 footcandles. For labs and multipurpose workrooms the standard is 100-150. State legislation requires the local board of education to consider the placement of windows to take advantage of the climate of North Carolina for both light and ventilation. It is recommended that grades 6-12 classrooms have window areas equal to or greater than 6-8% of the floor area. Standards are: K-5 - classrooms must have windows equal to or greater than 8% of the floor area. Grades 6-8 - classrooms must have windows. Grades 9-12 - no more than 20% of the total number of teaching stations may be windowless. Windows are required for 450 sq ft rooms where a student spends over 2 hrs and are recommended where possible for smaller spaces. Resource rooms occupied by one group for more than 2 hrs and all self contained rooms must have windows.

Lighting - Fluorescent

North Carolina Code
Care should be taken to insure that the characteristics of fluorescent lighting does not adversely affect children with certain disabilities.

Acoustics

North Carolina Code
Classrooms for hearing impaired programs will require special acoustical treatment of the finishes, the mechanical system and possibly the lighting ballast.

Ventilation

North Carolina Code
State legislation requires the local board of education to consider the placement of windows to take advantage of the climate of North Carolina for both light and ventilation (recommendations for windows under Lighting - General.)

Seating, Tables, Counters and Work Surfaces

Summary

Please see the Classroom section and the Seating section for quantitative summaries for this topic.

Background Specifications for Seating, Tables, Counters and Work Surfaces

General

UFAS (4.32.1 Minimum Number)
Fixed or built-in seating, tables, or work surfaces required to be accessible by 4.1 shall comply with 4.32.

Florida Children's Standards (6.4.1 General)
Accessible seating, tables, counters or work surfaces shall comply with this section.

(1) **Seating** Accessible seating spaces provided at tables or work surfaces for children in wheelchairs shall have a clear floor space complying with Section 5.5, Exterior Seating and Tables, and Fig. 6.3.

(2) **Arm Rest Clearances** Accessible seating for children in wheelchairs at tables and work surfaces shall have arm rest spaces at least 27 inches high, 30 inches wide (minimum), and 19 inches deep (minimum). (Fig 6.3)

(3) **Heights of Tables and Work Surfaces** The tops of tables, counters, and work surfaces shall be from 25 to 30 inches depending on the type of disability for which the classroom is designed.

Guidelines:

Different age children and different types of work require different work surface heights. If a classroom will be used by different age groups, appropriately sized furniture should be provided. In order to maintain proper body alignment, cut-out tables are recommended.

Comparative Dimensions

note: All dimensions are in inches

Item	Height	Width for Wheelchair	Clear Floor Space	Allowable Overlap	Minimum armrest Height	Depth
Table and Worksurface	25 - 30"	30	48 x 30	12	27	19
Counter	25 - 30"	36	48 x 36	12	27	19
Sink:						
Wall mounted		N.A.	48 x 36	12	N.A.	N.A.
Countertop			48 x 36	12	N.A.	N.A.
Wheelchair Accessible		36	48 x 36		27	17
Toilet		varies, see Fig. 8.1 - 8.5	varies, see Fig. 8.1 - 8.5	N.A.	N.A.	N.A.
Water Cooler		N.A.	48 x 36	17 - 19	27	17-19

Seating

UFAS (4.32.2 Seating)

If seating spaces for people in wheelchairs are provided at tables, counters, or work surfaces, clear floor space complying with 4.2.4 shall be provided. Such clear floor space shall not overlap knee space by more than 19in (485mm) (see Fig. 45).

ATBCB Children's Recommendations for Elementary Schools (1986)

UFAS 4.32.2 Seating, Tables and Work Surfaces - Seating. All provisions apply with the following additions: Chairs for children should be 15 in to 17 in (380mm to 430mm) high with backs and arms.

Heights of Tables and Work Surfaces

UFAS (4.32.4 Height of Work Surfaces)
The tops of tables and work surfaces shall be from 28in to 34in (710mm to 865mm) from the floor or ground.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.32.4 Seating, Tables and Work Surfaces - Height of Work Surfaces. All provisions apply with the following additions: The tops of tables and work surfaces used by children shall be a maximum of 30 in (760mm) from the floor or ground.

Florida Children's Standards
(see 6.4.1 above for specifications)

North Carolina Code
The top of tables, work stations, study or library carrels or other fixed facilities shall not be higher than 30in above the finished floor. Appendix A-17, Ref. 7.2 (c), pg. 232.

Knee Clearances

UFAS (4.32.3 Knee Clearances)
If seating for people in wheelchairs is provided at tables, counters, and work surfaces, knee space at least 27in (685mm) high, 30in (760mm) wide and 19in (485mm) deep shall be provided (see Fig. 45).

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.32.3 Seating, Tables and Work Surfaces - Knee Clearances. All provisions apply with the following addition: If seating for children in wheelchairs is provided at tables, counters, and work surfaces, knee spaces at least 24 in (610mm) high, 30 in (760mm) wide, and 19 in (485mm) deep shall be provided.

Florida Children's Standards
(see 6.4.1 above for specifications)

North Carolina Code
Minimum knee space from the underside of the table, work station, carrel or other fixed facility to the finished floor shall be 24in. Appendix A-17, Ref. 7.2 (a), pg. 232.

Storage

Summary

Table 15 summarizes the quantitative requirements for various aspects of storage (for children) as specified by the eight sources plus the UFAS.

Table 15
Storage

UFAS	Reference		UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.25.2	Clear Floor Space		30" X 48"		30" X 48"							
4.25.3	Height	AFF	54" max		36" max for wheelchair 48" max for ambulatory							
4.25.3	Clothing Rods	AFF	54" max		40" max		36" max					
	Clothing Hooks	AFF		36" max	36" max		36" max					
	Shelves	AFF		36" max			9" min 36" max				42" - 51" *	

* Range for max. height by age (5 -15) and approach.

Comments related to Table 15

The maximum heights for storage used by children is lower than the heights specified in the UFAS. Age is considered in the Texas code and explains the maximum height range from 42in to 51in. The ATBCB supplement, Florida and the North Carolina Code specify a maximum height of 36in.

Background Specifications for Storage

General

UFAS (4.25.1 General)
Fixed storage facilities such as cabinets, shelves, closets, and drawers required to be accessible by 4.1 shall comply with 4.25.

Clear Floor Space

UFAS (4.25.2 Clear Floor Space)
A clear floor space at least 30in by 48in (760 by 1220mm) complying with 4.2.4 that allows either a forward or parallel approach by a person using a wheelchair shall be provided at accessible storage facilities.

Florida Children's Standards (6.5.2 Clear Floor Space)
A clear floor space at least 36in by 48in complying with Section 9.2.2, Clear Floor Space (Figure 9.5), that allows either a forward or parallel approach by a person using a wheelchair shall be provided at accessible storage spaces.

Height

UFAS (4.25.3 Height)
Accessible storage spaces shall be within at least one of the reach ranges specified in 4.2.5 and 4.2.6. Clothes rods shall be a maximum of 54in (1370mm) from the floor (see Fig. 38).

Florida Children's Standards (6.5.3 Height)
Accessible storage spaces shall be a maximum of 36in for wheelchair access and 46in for ambulatory children. Maximum heights of clothes rods shall be 40in and hooks shall be a maximum of 36in from the finished floor. (Fig. 6.4, pg. 92.)

North Carolina Code
Clothes hanger rods and/or clothes hooks shall not be mounted higher than 36in above the finished floor. Appendix A-16, Ref. 5.5.1, pg. 231. Hanger rods may be adjustable in this range.

Hardware

UFAS (4.25.4 Hardware)
Hardware for accessible storage facilities shall comply with 4.27.4. Touch latches and U-shaped pulls are acceptable.
Florida Children's Standards (6.5.4 Hardware)
Hardware for accessible storage shall comply with Section 3.14.9, Door Hardware, except for height which shall comply with Section 6.5.3, Height. Touch latches are preferred but U-shaped pulls are acceptable.

Shelves

Texas
When children under high school age are the primary users of a building or facility, such as an elementary or middle school, mounting heights of various elements, fixtures and equipment shall be adjusted to meet the needs of the age group that the facility is to serve. For frontal approaches, maximum heights of shelves from floor surfaces shall be 42in for ages 5-11 and 45in for ages 11-15. For side approaches, maximum heights shall be 48in for ages 5-11 and 51in for ages 11-15.

Open Shelving

North Carolina Code
Appendix A-16, Ref. 5.5.1, pg. 231. Shelves may be mounted no less than 9in above the finished floor and may be adjustable in the range up to 36in.

Toilets, Urinals and Toilet Stalls

Summary

Table 16 summarizes the quantitative requirements for various aspects of toilets, urinals and toilet stalls (for children) as specified by the eight sources plus the UFAS.

Table 16
Toilets, Urinals, and Toilet Stalls

UFAS	References		UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.16.3	Toilet Height	AFF	17" - 19"	15" - 17"	10" - 15"		15" - 17"	15"	15"	18" max	14" - 17"	To top of seat
4.16.4	Grab Bar Height	AFF	33" - 36"	25" - 27"	24" *		25" - 27"					
4.16.5	Flush Controls	AFF	44"	32" max	≤30"					20"		
	Toilet Paper Dispenser Height	AFF	19" min to CL	19"	18" CL							
4.16.6	Distance from Rear Wall			18" - 24"	**					≤12" from end of water closet		
	Urinals											
4.18.2	Height	AFF	≤17"				14"				14" - 18" above CL	Rim height
4.18.3	Clear Floor Space		30" X 48"									
4.18.4	Controls	AFF	44" max	32" max			32"					
	Toilet Stalls											
4.17.3	Width		36",48",60"***		48",60"							
4.17.3	Length		56",59",96" min		60",72",100" min							Wall mounted vs. floor mounted
4.17.4	Toe Clearance	Depth x AFF	9" min		18" ****							Toilet - clear floor space
4.17.3	Clear Space Outside		42" - 48"		48"							At least one side, if stall width 60" or greater
4.17.5	Door Width		32" clear		36"							
4.17.6	Grab Bars - Height	AFF	33" - 36" CL	25" - 27" CL	Varies **		25" - 27" CL		10" seat			

* Florida requires an additional vertical bar attached to the floor and extending to 33" - 36" AFF. Saddle type bars can be used instead of vertical bars.

** Requires dispenser to be installed 8" behind centerline of grab bar (horizontal centerline).

*** The 60" wide stall is the only stall permitted in new construction

****min toe clearance on front partition and at least one side partition

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Comments related to Table 16

This table and table 17 contain the most variance that was found in comparison of the specifications from the nine sources. Toilet seat height varied from 14in to 17in for children compared with 17in to 19in in UFAS. Grab bar height for children varied from 24in to 27in and flush controls from 20in to 32in (AFF). Urinals were not specified in the ATBCB supplement or in the Florida guidelines but were specified in North Carolina and Texas. In those two states the heights varied from 14in to 16in while UFAS specifies a maximum height of 17in.

The 36in wide toilet stall is not specified in the Florida guidelines and cannot be used in new construction where the UFAS is required. Increased toe space for toilet stalls is specified in the Florida standards to accommodate raised footrests typically found on wheelchairs used by children.

Florida requires the use of a vertical grab bar mounted on a side wall in addition to two horizontal grab bars. The Florida standard also permits the use of "saddle type" grab bars on toilets.

Background Specifications for Toilets, Urinals and Toilet Stalls

General

UFAS (4.16.1 General)
Accessible water closets shall comply with 4.16. For water closets in accessible dwelling units, see 4.34.5.2.

Florida Children's Standards (8.3.1 General)
Accessible water closets shall comply with this section. There shall be at least one accessible water closet that provides privacy for the user.

Guidelines:

While privacy for a minimum of one toilet is required, it should be noted that many of the children using this toilet will also require assistance from one or two teachers or staff. In some such instances, curtains can be a viable alternative to doors, thus allowing access space for all parties.

North Carolina Code
Individual toilets for K-1 classrooms should be paired with the adjoining classrooms to provide a boy's toilet and a girl's toilet.

Clear Floor Space

UFAS (4.16.2 Clear Floor Space)
Clear floor space for water closets not in stalls shall comply with Fig. 28. Clear floor space may be arranged to allow either a left-handed or right-handed approach.

Florida Children's Standards (8.3.2 Clear Floor Space)
Clear floor space for water closets not in stalls shall comply with Fig. 8.1, pg.110. Clear floor space may be designed for either a right-hand or left-hand approach.

Height

UFAS (4.16.3 Height)
The height of water closets shall be 17in to 19in (430mm to 485mm), measured to the top of the toilet seat (see Fig. 29 (b)). Seats shall not be spring to return to a lifted position.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.16. Water Closets.

All Provisions apply with the following addition.

4.16.3 Height is supplemented by: The height of water closets used by children shall be 15 in to 17 in (380mm to 430mm), measured to the top of the toilet seat.

Florida Children's Standards (8.3.3 Height)
The height of a water closet to be used by children in the pre-kindergarten age group shall be 10in -12in measured to the top of the seat. Water closets to be used by grades K through 3 shall be 12-15in measured to the top of the seat. Seats shall not be spring-loaded to return to a lifted position. (Fig. 8.2 and 8.3, pgs. 111-112.)

North Carolina Code
Water closets shall have a height to the top of the seat not less than 15in nor more than 17in above the finished floor. Appendix A-9, Ref. 4.6.6 (a) (2), pg. 224.

Illinois 1978-88
In public facilities which primarily serve children, the following dimensions and accessories may be adjusted to suit the age of children to be accommodated in the facility: suggested height of water closets is 1ft3in.

Texas
When children under high school age are the primary users of a building or facility, such as an elementary or middle school, mounting heights of various elements, fixtures and equipment shall be adjusted to meet the needs of the age group that the facility is to serve. Heights of water closets from the floor surface to the tops of seats shall be no more than 14-15in for ages 5-11 and 15-17in for ages 11-15.

Michigan
Handrails, water closets, lavatories, and accessories for small children such as schoolchildren, shall meet the requirements for their use (I). Michigan does acknowledge that "this section is not as specific as might be desirable", so the Barrier Free Division and the Plumbing Division make some suggestions: use junior water closet fixtures or be sure that the seat height is not higher than 16in above the finished floor.

California
If facilities are intended for use specifically for students which may include disabled users under 12 years of age, the following criteria shall be used: toilet height shall be 1ft3in to top of seat from floor surface.

Grab Bars

UFAS (4.16.4 Grab Bars)
Grab bars for water closets not located in stalls shall comply with Fig. 29 and 4.26.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.16 Water Closets. All Provisions apply with the following addition.
4.16.4 Grab bars is supplemented by: Grab bars for water closets used by children and not located in stalls shall be mounted 25in to 27in (635mm - 685mm) above the floor.

Florida Children's Standards (8.3.4 Grab Bars)
Grab bars for water closets not located in toilet stalls shall comply with 8.12, Grab Bars and Tub and Shower Seats; Section 8.13, Structural Strength; and Fig. 8.2 and 8.3. One vertical grab bar shall be provided at one side of a water closet. As an alternative, saddle-type grab bars can be used and shall be located behind the front edge of the toilet bowl to a maximum of 4in, and to the side of the bowl 2in to 6in, and shall be a maximum of 24in apart, centered on the water closet. The vertical grab bars may be floor or wall mounted. Horizontal grab bars are to be provided as

shown in Fig. 8.2 and 8.3, pgs. 111-112. The diameter of all grab bars shall be 1in to 1.25in. Angled grab bars are not acceptable.

California
If facilities are intended for use specifically for students which may include disabled users under 12 years of age, toilet grab bar length alongside the water closet shall be 3ft, with 1ft 6in length extending beyond the front edge of the water closet.

North Carolina Code
Appendix A-9, Ref. 4.6.5, pg. 224.

Flush Controls

UFAS (4.16.5 Flush Controls)
Flush controls shall be hand operated or automatic and shall comply with 4.27.4. Controls for flush valves shall be mounted on the wide side of toilet areas no more than 44in (1120mm) above the floor.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.16. Water Closets.
All Provisions apply with the following addition.

4.16.5 Flush Controls is supplemented by: Controls for flush valves on water closets used by children shall be mounted on the wide side of the toilet areas no more than 32in (815mm) above the floor).

Florida Children's Standards (Flush Controls)
Flush controls shall comply with Section 9.2, Controls and Operating Mechanisms. Flush controls shall be hand operated or automatic. Flush controls that are not mounted directly on the water closet shall be mounted for use in the most accessible location, and shall be mounted at not more than 30in above the finished floor.

Michigan
Mount the flush control at 20in above the finished floor.

Toilet Paper Dispensers

UFAS (4.16.6 Dispensers)
Toilet paper dispensers shall be installed within reach, as shown in Fig. 29 (b). Dispensers that control delivery, or that do not permit continuous paper flow, shall not be used.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.16. Water Closets.
All Provisions apply with the following addition.

4.16.6 Dispensers is supplemented by: Toilet paper dispensers used by children shall be installed 19in (485mm) above the floor, 18in to 24in (460mm to 610mm) from the rear wall.

Florida Children's Standards (8.3.6 Toilet Paper Dispensers)
Toilet paper dispensers shall comply with Section 9.2, Controls and Operating Mechanisms. Toilet paper dispensers shall be installed so that the centerline of the dispenser is 8in behind the centerline of the vertical grab bar. The mid-line of the dispenser shall be located at 18in above the finished floor. (Figs. 8.2 and 8.3, pgs. 111-112.)

Michigan
Place the toilet paper holder on the side wall no further than 12in beyond the end of the water closet.

North Carolina Code
Appendix A-10, Ref. 4.6.7, pg. 225.

Urinals

Height

UFAS (4.18.2 Height)
Urinals shall be stall-type or wall-hung with an elongated rim at a maximum of 17in (430mm) above the floor.

Texas
For urinals, maximum distances to basin openings shall be 14in for ages 5-11 and 16in for ages 11-15.

North Carolina Code
For urinals, the rim shall be 14in above finish floor.

Clear Floor Space

UFAS (4.18.3 Clear Floor Space)
A clear floor space 30in by 48in (760mm by 1220mm) shall be provided in front of urinals to allow forward approach. This clear space shall adjoin or overlap an accessible route and shall comply with 4.2.4. Urinal shields that do not extend beyond the front edge of the urinal rim may be provided with 29in (735mm) clearance between them.

Controls

UFAS (4.18.4 Flush Controls)
Flush controls shall be hand operated or automatic, and shall comply with 4.27.4, and shall be mounted no more than 44in (1120mm) above the floor.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.18. Urinals.
All Provisions apply with the following addition.

4.18.4 Flush Controls is supplemented by: Flush controls on urinals used by children shall be mounted no more than 32in (815mm) above the floor).

North Carolina Code
Flush controls shall be 32in above finish floor.

Toilet Stalls

General

UFAS (4.17.1 Location)
Accessible toilet stalls shall be on an accessible route and shall meet the requirements of 4.17.

Florida Children's Standards (8.4.1 General)
Accessible toilet stalls shall comply with this section and shall be located within an accessible space.

Guidelines:

Most children in the pre-kindergarten and grades K-3 that have physical disabilities will need assistance in using the toilet. For this reason, toilet stalls are not generally recommended, however, in order to satisfy the privacy requirement of 8.3.1, they may be a design choice. Where toilet stalls are used they should be located as far from the main entrance to the personal hygiene area as practical, to help keep the child in the wheelchair out of the main traffic flow.

Water Closets

UFAS (4.17.2 Water Closets)
Water closets in accessible stalls shall comply with 4.16.

Size and Arrangement

UFAS (4.17.3 Size and Arrangement)
The size and arrangement of toilet stalls shall comply with Fig. 30 (a). Toilet stalls with a minimum depth of 56in (1420mm) (see fig. 30 (a)) shall have wall-mounted water closets. If the depth of toilet stalls is increased at least 3in (75mm), then a floor-mounted water closet may be used. Arrangements shown for stalls may be reversed to allow either a left- or right-hand approach.
EXCEPTION: In instances of alteration work where provision of a standard stall (Fig. 30(a)) is structurally impracticable or where plumbing code requirements prevent combining existing stalls to provide space, an alternate stall (Fig. 30(b)) may be provided in lieu of the standard stall.

Florida Children's Standards (8.4.3 Size and Arrangement)
The size and arrangement of accessible toilet stalls shall be as illustrated in either Fig. 8.4 (a) or (b), pg. 114. Arrangements shown for stalls may be reversed to allow either a right-hand or a left-hand approach. If there is only one stall provided, that stall must meet the minimum dimensions of Fig. 8.4 (a).

Toe Clearance

UFAS (4.17.4 Toe Clearances)
In standard stalls, the front partition and at least one side partition shall provide a toe clearance of at least 9in (230mm) above the floor. If the depth of the stall is greater than 60in (1525mm), then the toe clearance is not required.

Florida Children's Standards (8.4.4 Toe Clearance)
In standard stalls, the front partition and at least one side partition shall provide a toe clearance of at least 18in above the floor. If the width of the stall is 60in or >, then the toe clearance is not required.

Doors

UFAS (4.17.5 Doors)
Toilet stall doors shall comply with 4.13. If toilet stall approach is from the latch side of the stall door, clearance between the door side of the stall and any obstruction may be reduced to a minimum of 42in (1065mm).

Florida Children's Standards (8.4.5 Doors)
Toilet stall doors shall comply with Section 3.14, Doors, with the following modifications: all toilet stall doors shall be 36in in width; if the approach is to the latch side of the stall door, the clearance between the door side of the stall and any obstruction may be re-

duced to a minimum of 48in. See Fig. 8.4. All swinging type doors shall be equipped with a self-closing device and shall open out. Curtains that can be pulled across the stall opening may be substituted for the stall door. The use of curtains to provide privacy is especially useful for the first stall in a row.

Grab Bars

UFAS (4.17.6 Grab Bars)
Grab bars complying with the length and positioning shown in Fig. 30 (a), (b), (c) and (d) shall be provided. Grab bars may be mounted with any desired method as long as they have a gripping surface at the locations shown and do not obstruct the required clear floor area. Grab bars shall comply with 4.26.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.17. Toilet Stalls.
All Provisions apply with the following addition.

4.17.6 Grab Bars is supplemented by: Grab bars in toilet stalls to be used by children shall be mounted 25in to 27in above the floor (635mm to 685).

Florida Children's Standards (8.4.6 Grab Bars)
Grab bars shall comply with Section 8.12, Grab Bars. Grab bars complying with the location and sizes of grab bars as shown in Fig. 8.4, Fig. 8.5, Fig. 8.6, pgs. 114-116, shall be provided. Grab bars may be mounted in any manner complying with Section 8.13, Structural Strength, as long as they have a gripping surface corresponding with the given dimensions. A saddle-type set of grab bars may be substituted for the vertical bar located on the side of the water closet. Angled bars are not acceptable.

Illinois
In public facilities which primarily serve children, the following dimensions and accessories may be adjusted to suit the age of children to be accommodated in the facility. Suggested height of toilet stall grab bars is 10in above the seat. Bars shall be 3ft long, extending 1ft6in beyond the front edge of the water closet. Grab bars must be able to support a 150 lb load.

North Carolina Code
All grab bars shall be 1-1/4in to 1-1/2in in width or outside diameter. The clear hand space between the inner face of the grab bar and the finished face of the wall or partition shall be 1-1/2in. All grab bars shall be capable of supporting a 250 pound load applied in any direction anywhere along its length.

Lavatories, Bathtubs and Showers

Summary

Table 17 summarizes the quantitative requirements for various aspects of lavatories, bathtubs and showers (for children) as specified by the eight sources plus the UFAS.

Table 17
Lavatories, Bathtubs, and Showers

UFAS	Reference	UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
	Lavatories & Sinks										
4.19.2	Height AFF	34" max	≥30"	≥30"		30" max					
4.19.2	Vertical Clearance AFF	29" min	24" min	27" min		24" min	29"	29" min	28"	30" - 34" max	
4.24.3	Knee Space Height AFF	27" min	24" min	27" min		24" min				26" - 28" min	
4.24.3	Knee Space Width	30" min	28" min	30"		30" min					
4.24.3	Knee Space Depth	19" min	17" min	8" - 11" *		8"					* 12" max deep for sinks
4.19.2	Toe Space		6" max x 9"high min	6" max deep x 16" high min		6" max deep x 9" high min					
	Front to Faucet									16" - 20"	
4.24.4	Bowl Depth	6 1/2" max									
4.19.6	Mirrors - Bottom Height AFF	40"	30"	34" max tilted > 30"		34"				34" - 37"	
	Grab Bars			vertical to 4" above sink at side							
	Bathtubs										
4.20.2	Clear Floor Space	30" - 48" wide 60" - 75" long		48" wide 60" - 75" long		30" - 48" wide 60" - 75"					
4.20.4	Grab Bars - Top AFF	33" - 36" CL		24" - 28" CL		25" - 27"					On all 3 sides except rear seat
4.20.4	Grab Bars - Bottom	9" above tub rim		4" - 5" above tub rim		N/A					
	Showers										
4.21.2	Shower Stalls	36" X 36"		36" X 36"							
4.21.2	Roll-In Showers	30" X 60" min		30" X 60" min							
4.21.3	Seat Height AFF	17" - 19"	15" -17"	12" - 15"		15" - 17"					
4.21.5	Controls Height AFF	48" max	36" max	36" max		36" CL max					
4.21.6	Hose Length	60" min		72" min							Fixed & adjustable height required
4.21.7	Curbs AFF	0" - 1/2" max		4" max							
4.21.6	Fixed Shower Height AFF					66"					
4.21.5	Hose Connection AFF					48"					

Comments related to Table 17

Provisions for lavatories, bathtubs and showers generally call for lower heights than in the UFAS. Seat height for the shower has a variance of five inches (12in-17in). Sink height, grab bar height, control height and the hose connection for the shower are all at lower heights than adult provisions.

Clear floor space next to bathtubs is larger for the Florida guidelines perhaps to provide additional space for assistance. Florida also permits a 4in curb on the 36in by 36in stall shower which limits its use by people using wheelchairs.

Background Specifications for Lavatories, Bathtubs and Showers

General

Florida Children's Standards (8.5.1 General)
Accessible lavatory fixtures, built-in lavatories, and vanities in targeted schools and targeted classrooms shall comply with this section. Each accessible area for personal hygiene shall have a minimum of two lavatories or sinks or a combination of the two or one side access sink. One side access sink mounted at a height for use by ambulatory students, 22 inches for prekindergarten and 25 inches for grades K-3 with clear access and fixtures as shown in Fig. 8.10, will meet the two-sink requirement. The two lavatories or sinks shall be mounted at different heights, corresponding to the requirements of both ambulatory and wheelchair user children. One of the two may be located in the classroom that is adjacent to the personal hygiene area.

Lavatories - Heights and Clearances

UFAS (4.19.3 Lavatories and Mirrors)
Lavatories shall be mounted with the rim or counter surface no higher than 34" (865 mm) above the finished floor. Provide a clearance of at least 29" (735 mm) from the floor to the bottom of the apron. Knee and toe clearance shall comply with Fig. 31.

UFAS (4.24.3 Knee Clearance)
Knee clearance that is at least 27" (685 mm) high, 30" (760 mm) wide, and 19" (485 mm) deep shall be provided underneath sinks.

Florida Children's Standards (8.5.2 Heights and Clearances)

8.5.2.1 Lavatories

(1) The wheelchair accessible lavatories shall be mounted with the rim height at no more than 30" above the floor and with a clearance of at least 27" from the floor to the bottom of the apron. Knee and toe clearances shall comply with Fig. 8.7, pg. 118.

(2) The ambulatory accessible lavatories shall be mounted with the rim height as shown in Fig. 8.8, pg. 118, for the different grade levels.

ATBCB Children's Recommendations for Elementary Schools (1986)

UFAS 4.19. Lavatories and Mirrors. All Provisions apply with the following addition.

4.19.2 Height and Clearances is supplemented by: Lavatories used by children shall be mounted with the rim or counter surface no higher than 30" (760 mm) above the finished floor. Provide a clearance of at least 24" (610 mm) from the floor to the bottom of the apron. Knee and toe clearance shall comply with modified Fig. 31 (below).

UFAS 4.24.2 Height. All provisions apply with the following addition:

Sinks used by children shall be mounted with the counter or rim no higher than 30" (760 mm) from the floor.

UFAS 4.24.3 Knee Clearances. All provisions apply with the following addition:

Knee clearance that is a minimum of 24" (610 mm) high, 28" (710 mm) wide, and 17" (430 mm) deep shall be provided underneath sinks used by children.

North Carolina Code

The clear floor space specified in Section 4.6.6 (b) (1) shall extend under the lavatory a minimum of 8". Lavatory depth shall be 17" measured horizontally from the forward edge of the lavatory to the finished face of the rear wall. Knee space from the finished floor to the bottom of the lavatory apron or bottom of the countertop shall be 24". The rim of the lavatory or finished surface of the countertop shall not be higher than 30" above the finished floor. Appendix A-9, Ref. 4.6.6 (b), pg. 224.

Illinois 1978-88

In public facilities which primarily serve children, the following dimensions and accessories may be adjusted to suit the age of children to be accommodated in the facility. Suggested lavatory heights shall be 2'-5" from floor to bottom of apron.

Texas

When children under high school age are the primary users of a building or facility, such as an elementary or middle school, mounting heights of various elements, fixtures and equipment shall be adjusted to meet the needs of the age group that the facility is to serve.

Frontal Approaches:

Minimum knee clearance:

Ages 5-11 (Grades K-6)	26"
Ages 11-15 (Grades 6-9)	28"

Maximum height to top of lavatory:

Ages 5-11 (Grades K-6)	30"
Ages 11-15 (Grades 6-9)	32"

Maximum distance from front of lavatory to faucet:

Ages 5-11 (Grades K-6)	18"
Ages 11-15 (Grades 6-9)	20"

Side Approaches:

Maximum height for top of lavatory:

Ages 5-11 (Grades K-6)	32"
Ages 11-15 (Grades 6-9)	34"

Maximum distance from front of lavatory to faucet:

Ages 5-11 (Grades K-6)	16"
Ages 11-15 (Grades 6-9)	18"

Michigan

Handrails, water closets, lavatories, and accessories for small children such as schoolchildren, shall meet the requirements for their use. Michigan does acknowledge that "this section is not as specific as might be desirable", so the Barrier Free Division and the Plumbing Division make some suggestions: provide a lavatory so that there is a 28" clearance beneath the lavatory (so the child in a wheelchair can get close enough to be able to use the sink).

California

Where facilities are to be used solely be small children, the specific heights may be adjusted to meet their accessibility needs. If facilities are intended for use specifically for students which may include disabled users under 12 years of age, lavatory heights shall be 2'5" below the apron to the floor surface.

Sinks - General

UFAS (4.24.1 General)
Sinks required to be accessible by 4.1 shall comply with 4.24. Sinks in kitchens of accessible dwelling units shall comply with 4.34.6.5.

Florida Children's Standards (8.5.1 General) (editors note: see background section at the beginning of Lavatories and Sinks.)

Sinks - Height

UFAS (4.24.2 Height)
Sinks shall be mounted with the counter or rim no higher than 34" (865 mm) from the floor.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.24.2 Height. All provisions apply with the following additions:
Sinks used by children shall be mounted with the counter or rim no higher than 30" (760 mm) from the floor.

Sinks - Knee Clearance

UFAS (4.24.3 Knee Clearance)
Knee clearance that is at least 27in (685mm) high, 30in (760mm) wide, and 19in (485mm) deep shall be provided underneath sinks.

Sinks -Depth

UFAS (4.24.4 Depth)
Each sink shall be a maximum of 6.5" (165 mm) deep.

Clear Floor Space

UFAS (4.19.3 Clear Floor Space)
A clear floor space 30in by 48in (760mm by 1220mm) complying with 4.2.4 shall be provided in front of a lavatory to allow forward approach. Such clear floor space shall adjoin or overlap an accessible route and shall extend a maximum of 19in (485mm) underneath the lavatory (see Fig. 32).

Florida Children's Standards (8.5.2.3 Clear Floor Space)
A clear floor space 30in by 48in shall be provided in front of all accessible lavatories to allow forward approach. Such clear floor space shall adjoin or overlap an accessible route and shall extend a maximum of 12in underneath the lavatory (Figure 8.9).

North Carolina Code
A clear floor space 30in by 48in shall be provided in front of lavatory.

Michigan
Other lavatories (Lavatories - Heights and Clearances above) may need to be lower and typically mounted about 2ft above the finished floor.

Texas
When children under high school age are the primary users of a building or facility, such as an elementary or middle school, mounting heights of various elements, fixtures and equipment shall be adjusted to meet the needs of the age group that the facility is to serve. For frontal approaches to lavatories, minimum knee clearances for ages 5-11 (grades K- 6) shall be 26in; for ages 11-15 (grades 6-9), it shall be 28in. Maximum height to top of lavatory shall be 30in for ages 5-11 and 32in for ages 11-15.

Exposed Pipes and Surfaces

UFAS (4.19.4 Exposed Pipes and Surfaces)
Hot water and drain pipes under lavatories shall be insulated or otherwise covered. There shall be no sharp or abrasive surfaces under lavatories.

UFAS (4.24.6 Exposed Pipes and Surfaces)
Hot water and drain pipes exposed under sinks shall be insulated or otherwise covered. There shall be no sharp or abrasive surfaces under sinks.

Florida Children's Standards (8.5.3 Exposed Pipes and Surfaces
Only the lavatory or sink that is wheelchair accessible is required to have hot water. All exposed hot water pipes and drain pipes that receive hot water shall be insulated or otherwise protected where they abut the clearance spaces illustrated in Figs. 8.7 and 8.8, pg.118. There shall be no exposed sharp or abrasive surfaces under the lavatories or sinks.

North Carolina Code
Hot water supply and drain lines shall be fully insulated with a removable non-metallic baffle. (Figure 4.6.6(b) page 224 NC)

Faucets

UFAS (4.19.5 Faucets, 4.24.7 Faucets)
Faucets shall comply with 4.27.4. Lever-operated, push-type and electronically controlled mechanisms are examples of acceptable

designs. Self-closing valves are allowed if the faucet remains open for at least 10 seconds.

UFAS (4.24.7 Faucets)

Faucets shall comply with 4.27.4. Lever-operated, push-type, touch-type, or electronically controlled mechanisms are acceptable designs.

Florida Children's Standards (8.5.4 Faucets)

Faucets shall comply with Section 9.2, Controls and Operating Mechanisms. Conventional quarter-turn, blade-operated type of faucets shall be used. A minimum of one sink or lavatory at each of the different mounting heights shall be equipped with a drinking bubbler as shown in Fig. 8.10, pg. 120. Self-closing faucets shall be used to comply with Section 6A-a, FAC (Florida code).

Guidelines:

Forward reach is very limited for many handicapped children. It is recommended that all faucets be mounted on the side of the lavatory sink if possible. (Fig. 8.10)

Mirrors

UFAS (4.19.6 Mirrors)

Mirrors shall be mounted with the bottom edge of the reflecting surface no higher than 40in (1015mm) from the floor (see Fig. 31).

Florida Children's Standards (8.5.5 Mirrors)

Mirrors shall be mounted so that the bottom of the reflecting surface is no more than 34in above the floor. If there is a conflict with the faucet handles or backsplash, the bottom edge of the reflecting surface shall be mounted as low as possible. Mirrors that are mounted at more than 30in above the floor shall be tilted out from the wall at the top of the mirror equal to a minimum of 1/2in for every foot in height measured from the top to bottom edge of the reflecting surfaces.

Texas

When children under high school age are the primary users of a building or facility, such as an elementary or middle school, mounting heights of various elements, fixtures and equipment shall be adjusted to meet the needs of the age group that the facility is to serve. Maximum distances to bottoms of mirrors shall be 34in for ages 5-11 and 37in for ages 11-15.

North Carolina Code

Mirrors shall be mounted so that the bottom of the reflecting surface is 34in above finished floor.

ATBCB Children's Recommendations for Elementary Schools (1986)
Reference UFAS 4.19 Lavatories and Mirrors:
All provisions apply with the following additions:
Mirrors used by children shall be mounted with the bottom edge of the reflecting surface no higher than 30in (760mm) from the floor or as low as possible if there are conflicts with the faucet handle or backsplash.

Towel Bars and Soap Dispensers

North Carolina Code
Towel bars, cup dispensers, paper towel dispensers shall be mounted with their bottom edge 36in above finished floor.

Bathtubs

Clear Floor Space

UFAS (4.20.2 Floor Space)
Clear floor space in front of bathtub shall be as shown in Fig. 33.

Florida Children's Standards (8.6.2 Clear Floor Space)
Clear floor space in front of bathtubs shall be as shown in Fig. 8.11, pg. 122.

Seat

UFAS (4.20.3 Seat)
An in-tub seat or a seat at the head end of the tub shall be provided as shown in Fig. 33 and 34. The structural strength of seats and their attachments shall comply with 4.26.3. Seats shall be mounted securely and shall not slip during use.
Florida Children's Standards (8.6.3 Seat)
An in-tub seat or a seat at the head of the tub shall be provided as shown in Figs. 8.11 & 8.12, pgs. 122,123. Seats shall be mounted securely and shall not slip during use. All seats shall have a textured surface to prevent slipping.

North Carolina Code
The bathtub seat, regardless of type, shall support a load of not less than 150 pounds.

Grab Bars

UFAS (4.20.4 Grab Bars)
Grab bars complying with 4.26 shall be provided as shown in Fig. 33 and 34.

Florida Children's Standards (8.6.4 Grab Bars)
All grab bars shall comply with Section 8.12, Grab Bars and Tub and Shower Seats, and Section 8.13, Structural Strength, and shall be provided as shown in Figs. 8.11 & 8.12, pgs. 122,123.

North Carolina Code
Control end wall and the end wall at the head of the bathtub shall have the grab bar at not less than 25in nor more than 27in above the finished floor. On the wall parallel to the bathtub length, the upper grab bar shall not be less than 25in nor more than 27in above the finished floor. Bathtub grab bars shall have an outside diameter of 1.25in. Appendix A-12, Ref. 4.6.9 (c) (3), pg. 227. Note the use of one grab bar parallel to the long dimension of the tub at accessible bathtubs for children.

Controls

UFAS (4.20.5 Controls)
Faucets and other controls complying with 4.27.4 shall be located as shown in Fig. 34.

Florida Children's Standards (8.6.5 Controls)
Faucets and all other controls shall comply with Section 9.2, Controls and Operating Mechanisms, and shall be located as shown in Fig. 8.11 and 8.12.

Shower Units

UFAS (4.20.6 Shower Unit)
A shower spray unit with a hose at least 60in (1525mm) long that can be used as a fixed shower head or as a hand-held shower shall be provided.

Florida Children's Standards (8.6.6 Shower Units)
A shower spray unit shall be provided with a hose at least 72in long that can be used as a hand held unit and as an adjustable height shower head on a vertical bar. The vertical bar shall be at least 24in long and shall be mounted so as not to obstruct the use of grab bars. (Fig. 8.12, pg. 123.)

North Carolina Code
Appendix A-12, Ref. 4.6.9 (c) (3), pg. 227.

Bathtub Enclosures

UFAS (4.20.7 Enclosures)
If provided, enclosures for bathtubs shall not obstruct controls or transfer from wheelchairs onto bathtub seats or into tubs. Enclosures on bathtubs shall not have tracks mounted on their rims.

Florida Children's Standards (8.6.7 Bathtub Enclosures)
If bathtub enclosures are provided, they shall not obstruct the accessibility of controls or transfer from a wheelchair into the bathtub or on to a bathtub seat. Enclosures on bathtubs shall not have tracks attached to the rim of the tub.

Shower Stalls

Size and Clearance

UFAS (4.21.2 Size and Clearances)
Shower stall size and clear floor space shall comply with Fig. 35 (a) or (b). The shower stall in Fig. 35 (a) shall be 36in by 36in (915mm by 915mm). The shower stall in Fig. 35 (b) will fit into the space required for a bathtub.

Florida Children's Standards (8.7 2 Size and Clearance)
Shower stall size and clear floor space for access shall comply with Figs. 8.14 and 8.15. Stalls shall be a minimum of 48in in length and 36in deep. Stalls may be arranged for either a left or right hand approach.

Seat

UFAS (4.21.3 Seat)
A seat shall be provided in shower stalls 36in by 36in (915mm by 915mm) and shall be as shown in Fig. 36. The seat shall be mounted 17in to 19in (430mm to 485mm) from the bathroom floor and shall extend the full depth of the stall. The seat shall be on the wall opposite the controls. The structural strength of seats and their attachments shall comply with 4.26.3.

Florida Children's Standards (8.7.3 Seat)
A seat shall be provided in all shower stalls as shown in Fig. 8.13, pg. 125. The seat shall be mounted 12in - 15in from the floor of the shower, and shall extend the full depth of the shower stall. The structural strength of the seat and its attachments shall comply with Section 8.13, Structural Strength.

North Carolina Code
Appendix A-11, Refs. 4.6.8 (b) (4) and 4.6.8 (b) (5), pg. 226. Shower seats shall be mounted no less than 15in and no more than 17in above the finished floor.

ATBCB Children's Recommendations for Elementary Schools (1986)
Reference UFAS 4.21.3 Seat: All provisions apply with the following addition:
The seat provided in shower stalls used by children shall be mounted 15" to 17" (380 mm to 430 mm) from the bathroom floor and shall extend the full depth of the stall.

Grab Bars

UFAS (4.21.4 Grab Bars)
Grab bars complying with 4.26 shall be provided as shown in Fig. 37.

Florida Children's Standards (8.7.4 Grab Bars)
Grab bars shall comply with Section 8.12, Grab Bars and Tub and Shower Seats and shall be provided as shown in Figs. 8.16 and 8.17, pg. 126.

North Carolina Code
The grab bar (or bars) shall not be less than 25in nor more than 27in above the finished floor. All grab bars shall be 1.25in outside diameter. Appendix A-12, Ref. 4.6.8, pg. 226, 227.

Controls

UFAS (4.21.5 Controls)
Faucets and other controls complying with 4.27.4 shall be located as shown in Fig. 37. In shower stalls 36in by 36in (915mm by 915mm), all controls, faucets, and the shower unit shall be mounted on the side wall opposite the seat.

North Carolina Code
The common horizontal centerline of the controls, diversion valve and recessed soap tray shall not be higher than 36in above the finished floor. Appendix A-12, Ref. 4.6.8, pg. 226, 227.

ATBCB Children's Recommendations for Elementary Schools (1986)
Reference UFAS 4.21.5 Controls. All provisions apply with the following addition:
Faucets and other controls in shower stalls used by children complying with UFAS 4.27.4 shall be located as shown in modified figure 37.

Shower Unit

UFAS (4.21.6 Shower Unit)
A shower spray unit with a hose at least 60" (1525 mm) long that can be used as a fixed shower head or as a hand-held shower

shall be provided. EXCEPTION: In unmonitored facilities where vandalism is a consideration, a fixed shower head mounted at 48" (1220 mm) above the shower floor may be used in lieu of a hand held shower head.

Florida Children's Standards (8.7.6 Shower Unit)
A hand shower spray unit shall be provided with a hose at least 72" in length. An adjustable vertical mounting bar for the shower head shall be provided as shown in Figs. 8.16 and 8.17, pg. 126. The vertical bar shall be installed so as not to obstruct the use of any of the grab bars.

Curbs

UFAS (4.21.7 Curbs)
If provided, curbs in shower stalls 36in X 36in (915mm X 915mm) shall be no higher than 1/2in (13mm). Stalls 30in X 60in (760mm X 1525mm) shall not have curbs.

Florida Children's Standards (8.7.7 Curbs)
Curbs for shower stalls shall be no higher than 4in above the bathroom floor.

Shower Enclosures

UFAS (4.21.8 Shower Enclosures)
If provided, enclosures for shower stalls shall not obstruct controls or obstruct transfer from wheelchairs onto shower seats.

Florida Children's Standards (8.7.8 Shower Enclosures)
If shower enclosures are provided, they shall not obstruct the controls or transfer from wheelchairs onto the shower seat.

Fixed Shower Heads

North Carolina Code
The fixed shower head shall be located at 66in above the finished floor. Appendix A-12, Ref. 4.6.8, pg. 226, 227.

Flexible Hose-to-Wall Connection

North Carolina Code
The hose-to-wall connection shall be located at 48in above the finished floor. Appendix A-12, Ref. 4.6.8, pg. 226, 227.

Bathrooms, Bathing Facilities, Shower and Toilet Rooms

General

UFAS (4.23.8 Bathing and Shower Facilities)
If tubs or showers are provided, then at least one accessible tub that complies with 4.20 or at least one accessible shower that complies with 4.21 shall be provided.

Florida Children's Standards (8.6.1 General)
Accessible bathtubs shall comply with this section. Each targeted classroom shall have access to a personal hygiene area that includes either a tub or shower.

Minimum Number

UFAS (4.23.1 Minimum Number)
Bathrooms, bathing facilities, or shower rooms required to be accessible by 4.1 shall comply with 4.23 and shall be on an accessible route. For adaptable bathrooms in accessible dwelling units, see 4.34.5.

UFAS (4.22.1 Minimum Number)
Toilet facilities required to be accessible by 4.1 shall comply with 4.22. Accessible toilet rooms shall be on an accessible route.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.22.1 Minimum Number. All provisions apply with the following addition:
In toilet rooms to be used by children, the supplementary recommendations in this document for 4.13, 4.16, 4.17, 4.18, 4.19 and 4.27 shall be applied where those sections are referenced in 4.22.

Doors

UFAS (4.23.2 Doors, 4.22.2 Doors)
Doors to accessible bathrooms shall comply with 4.13.
Doors shall not swing into the floor space required for any fixture.

Florida Children's Standards (8.8.2 Doors)
Doors to all accessible bathrooms, bathing facilities, shower rooms, and toilet rooms shall comply with Section 3.14, Doors. Doors may swing into the clear floor space required for any fixture only in a bathroom or toilet room that is for individual use. Provide adequate maneuvering space shall be provided as shown in Fig. 8.18, pg. 128 (editors note: 60in minimum turning radius; 72in is preferred).

Clear Floor Space

UFAS (4.23.3 Clear Floor Space)
Accessible fixtures and controls required in 4.23.4, 4.23.5 Urinals, 4.23.6, 4.23.7, 4.23.8, and 4.23.9 shall be on an accessible route. Unobstructed turning spaces complying with 4.2.3 shall be provided within an accessible bathroom. The clear floor spaces at fixtures and controls, the accessible route, and the turning space may overlap. EXCEPTION: In bathrooms with only one water closet, one lavatory, and one bathtub or shower, a clear floor space of 30" by 60" (815 mm by 1525 mm) may be used in lieu of the unobstructed turning space.

UFAS (4.22.3 Clear Floor Space)
The accessible fixtures and controls required in 4.22.4, 4.22.5, 4.22.6, and 4.22.7 shall be on an accessible route. An unobstructed turning space complying with 4.2.3 shall be provided within an accessible toilet room. The clear floor space at fixtures and controls, the accessible route, and the turning space may overlap. EXCEPTION: In toilet rooms with only one water closet and one lavatory, a clear floor space of 30" by 60" (815 mm by 1525 mm) may be used in lieu of the unobstructed turning space.

Florida Children's Standards (8.8.3 Clear Floor Space)
Accessible fixtures and controls shall comply with Section 8.0, Personal Hygiene. These shall be on an accessible route and an unobstructed turning space, as shown in Fig. 8.18, pg. 128, shall be provided. No floor mounted fixtures shall protrude into this clear floor space. Any wall mounted fixture that has clearance of at least 16" above the floor may protrude into the clear turning space by a maximum of 12". The clear floor spaces and clearances required for the different fixtures and controls, the accessible route, and the clear turning space may overlap.

Water Closets

UFAS (4.23.4 Water Closets, 4.22.4 Water Closets)
If toilet stalls are provided, then at least one shall comply with 4.17; its water closet shall comply with 4.16. If water closets are not in stalls, then at least one shall comply with 4.16.

UFAS (4.22.4 Water Closets)
If toilet stalls are provided, then at least one shall comply with 4.17; its water closet shall comply with 4.16. If water closets are not in stalls, then at least one shall comply with 4.16.

Urinals

UFAS (4.23.5 Urinals)
If urinals are provided, then at least one shall comply with 4.18

UFAS (4.22.5 Urinals)
If urinals are provided, then at least one shall comply with 4.18.

North Carolina Code
Rim height shall be 14in above the finished floor. Appendix A-10, Ref. 4.6.6 (c), pg. 225.

Lavatories and Mirrors

UFAS (4.23.6 Lavatories and Mirrors)
If lavatories and mirrors are provided, then at least one of each shall comply with 4.19.

UFAS (4.22.6 Lavatories and Mirrors)
If lavatories and mirrors are provided, then at least one of each shall comply with 4.19.

North Carolina
Mirrors over accessible lavatories or adjacent to these lavatories shall have their bottom edge at 34" above the finished floor. Appendix A-10, Ref. 4.6.7, pg. 225.

Controls and Dispensers

UFAS (4.23.7 Controls and Dispensers)
If controls, dispensers, receptacles or other equipment is provided, then at least one of each shall be on an accessible route and shall comply with 4.27.

UFAS (4.22.7 Controls and Dispensers)
If controls, dispensers, receptacles, or other equipment is provided, then at least one of each shall be on an accessible route and shall comply with 4.27.

North Carolina Code
Dispensers, if provided, shall have the coin slot, operating lever, push button control and dispensing slot or opening not more than 36in above the finished floor. Appendix A-10, Ref. 4.6.7, pg. 225.

Medicine Cabinets

UFAS (4.23.9 Medicine Cabinets)
If medicine cabinets are provided, at least one shall be located with a usable shelf no higher than 44in (1120mm) above the floor space. The floor space shall comply with 4.2.4.

Shelves

North Carolina Code

If shelves are provided, at least one shelf shall have a height to the finished top surface of 34in above the finished floor. Appendix A-10, Ref. 4.6.7, pg. 225.

Towel Bars

North Carolina Code

Towel bars shall be located 36in above the finished floor. Appendix A-10, Ref. 4.6.7, pg. 225.

Grab Bars and Tub and Shower Seats

General

UFAS (4.26.1 General)

All handrails, grab bars, and tub and shower seats required to be accessible by 4.1, 4.8, or 4.9 shall comply with 4.26.

Size and Spacing

UFAS (4.26.2 Size and Spacing)

The diameter or width of the gripping surfaces of a handrail or grab bar shall be 1.25in by 1.5in (32mm by 38mm), or the shape shall provide an equivalent gripping surface. If handrails or grab bars are mounted adjacent to a wall, the space between the wall and the grab bar shall be 1.5in (38mm) (see Fig. 39 (a), (b), and (c)). Handrails may be located in a recess if the recess is a maximum of 3in (75mm) deep and extends at least 18in (455mm) above the top of the rail (see Fig. 39 (d)).

Florida Children's Standards (Size and Spacing of Grab Bars)

The diameter or width of the gripping surface of a grab bar shall be between 1in and 1 1/4in, or the shape shall provide an equivalent gripping surface. When mounted to a wall surface, the space between the wall and the grab bar gripping surface shall be 1 1/2in. The gripping surface of all grab bars shall be a non-slip surface.

California

Where facilities are to be used solely by small children, the specific heights may be adjusted to meet their accessibility needs. If facilities are intended for use specifically for students which may include disabled users under 12 years of age, toilet grab bar size shall be 1.25in with 1.5in between grab bar and wall.

North Carolina Code

All grab bars shall be 1.25in in width or diameter. Appendix A-9, Ref. 4.6.5, pg. 224.

Height

North Carolina Code

Regardless of the type of toilet stall, all grab bars shall be mounted not less than 25in nor more than 27in above the finished floor. The top of the shower seat shall not be less than 15in nor more than 17in above the finished floor. Appendix A-9, Ref. 4.6.5, pg. 224.

California

Where facilities are to be used solely by small children, the specific heights may be adjusted to meet their accessibility needs. If facilities are intended for use specifically for students which may include disabled users under 12 years of age, toilet grab bars shall be mounted 10in above the seat.

Texas

When children under high school age are the primary users of a building or facility, such as an elementary or middle school, mounting heights of various elements, fixtures and equipment shall be adjusted to meet the needs of the age group that the facility is to serve. Heights of grab bars from the floor surface to the top of the bar shall be 28-30in for ages 5-11 and 30-32in for ages 11-15.

Structural Strength

UFAS (4.26.3 Structural Strength)

The structural strength of grab bars, tub and shower seats, fasteners, and mounting devices shall meet the following specification: (1) Bending stress in a grab bar or seat induced by the maximum bending movement from the application of 250 lbf (1112 N) shall be less than the allowable stress for the material of the grab bar or seat. (2) Shear stress induced in a grab bar or seat by the application of 250 lbf (1112N) shall be less than the allowable shear stress for the material of the grab bar or seat. If the connection between the grab bar or seat and its mounting bracket or other support is considered to be fully restrained, then direct and torsional shear stresses shall be totaled for the combined shear stress, which shall not exceed the allowable shear stress. (3) Shear force induced in a fastener or mounting device from the application of 250 lbf (1112 N) shall be less than the allowable later load of either the fastener or mounting device or the supporting structure, whichever is the smaller allowable load. (4) Tensile force induced in a fastener by a direct tension force of 250 lbf (1112N) plus the maximum moment from the application of 250 lbf

(1112N) shall be less than the allowable withdrawal and the supporting structure. (5) Grab bars shall not rotate within their fittings.

Florida Children's Standards (8.13.1 General)
The structural strength of grab bars, tub and shower seats, fasteners, and mounting devices shall meet the following specifications: (1) Bending stress in a grab bar or seat induced by the maximum bending movement from the application of 250 pounds force shall be less than the allowable stress for the material of the grab bar or seat.

(2) Shear stress induced in a grab bar or seat by the application of 250 pounds force shall be less than the allowable shear stress for the material of the grab bar or seat. If the connection between the grab bar or seat and its mounting bracket or other support is considered to be fully restrained, then direct and torsional shear stresses shall be totaled for the combined shear stress, which shall not exceed the allowable shear stress.

(3) Shear force induced in a fastener or mounting device from the application of 250 pounds force shall be less than the allowable lateral load of either the fastener or mounting device or the supporting structure, whichever is the smaller allowable load.

(4) Tensile force in a fastener by a direct tension force of 250 pounds force plus the maximum moment from the application of 250 pounds force shall be less than the allowable withdrawal load between the supporting structure and the fastener.

(5) Grab bars shall not be able to be rotated within their fittings.

Guidelines:

Sinks and water closets that are wall-hung shall have reinforcing adequate to hold children that lean on the fixtures for balance and support.

California
Where facilities are to be used solely by small children, the specific heights may be adjusted to meet their accessibility needs. If facilities are intended for use specifically for students which may include disabled users under 12 years of age, grab bars must be capable of supporting a 150 lbf load applied anywhere along the length. Connections must also be capable of supporting a 150 lbf load.

North Carolina Code
All grab bars, whether horizontal or vertical, shall support a 150 pound load applied in any direction anywhere along its length.

Shower and tub seats, regardless of type, shall support a load of not less than 150 pounds.

Eliminating Hazards

UFAS (4.26.4 Eliminating Hazards)
A handrail or grab bar and any wall or other surface adjacent to it shall be free of any sharp or abrasive elements. Edges shall have a minimum radius of 1/8" (3.2 mm).

Florida Children's Standards (8.14.1 General)
A grab bar and any other surface adjacent to it shall not be of any sharp or abrasive elements. Edges shall have a minimum radius of 1/8".

Drinking Fountains and Water Coolers

Summary

Table 18 summarizes the quantitative requirements for various aspects of drinking fountains and water coolers (for children) as specified by the eight sources plus the UFAS.

Table 18
Drinking Fountains & Water Coolers

UFAS Reference		UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.15.2	Spout Height AFF	36" max	30"	30" max		30"	30"	30"		32" - 43"	May limit approach to side only if inadequate knee space
4.15.3	Spout Location	front		front							
4.15.3	Water Flow	min 4" vertical		min 4" vertical							
	Controls										
4.15.4	Location	front or side									
4.15.4	Type			blade/push bars							
	Knee Space										
4.15.5	Vertical AFF	27" min	24" min	27" min		24" min					
4.15.5	Depth	8" min	8" min	17" - 19"							
4.15.5	Width	30" min		36" min							
4.15.5	Toe Space	6"d X 9" m high	6"d X 9" m high								

Comments related to Table 18

The children's provisions generally call for a lower spout height for water coolers. Most common is the 30in height as compared to the UFAS specification of 36in max. Texas specifies a range from 32in to 43in.

One problem that was mentioned with the lower spout height is inadequate knee space for frontal approaches. Currently the Florida guidelines specify a 30in maximum spout height and a 27in minimum height for the kneespace which results in a 3in space for the water cooler bowl, control and plumbing.

Background Specifications for Drinking Fountains and Water Coolers

Minimum Number

UFAS (4.15.1 Minimum Number)
Drinking fountains or water coolers required to be accessible by 4.1 shall comply with 4.15.

Spout Height

UFAS (4.15.2 Spout Height)
Spouts shall be no higher than 36" (915 mm), measured from the floor or ground surface to the spout outlet (see Fig. 27 (a)).

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.15 Drinking Fountains and Water Coolers. All Provisions apply with the following addition.

4.15.2 Spout Height is supplemented by: Spouts on drinking fountains and water coolers used by children shall be no higher than 30" (760 mm), measured from the floor or ground surfaces to the spout outlet.

Florida Children's Standards (9.1.2 Spout Height)
Spouts shall be no higher than 30", measured from the floor or ground surface to the spout outlet. (Fig. 9.1)

Guidelines:

A 30" height will limit the approach method used at the drinking fountain. Most equipment requires an average bowl depth, including controls, of 7", which leaves only 23" for knee clearance for a forward approach--inadequate! If appears if the 30-inch dimension is used, the equipment may generally be limited to side approach only. When equipment is placed beneath the bowl of the drinking fountain intended for a forward approach, it may be in the way of the footrest on the wheelchair. Handicapped children may have their footrest as high as 18" above the finished floor.

California

Where facilities are to be used solely by small children, the specific heights may be adjusted to meet their accessibility needs. If facilities are intended for use specifically for students which may include disabled users under 12 years of age, height of water fountain spigots shall be 2'6" from the floor surface.

Illinois

In public facilities which primarily serve children the following dimensions and accessories may be adjusted to suit the age of the children to be accommodated in the facility. Suggested height of drinking fountain spouts is 2'6" above the finished floor.

North Carolina Code

The spout shall not be higher than 30" above the finished floor. Appendix A-13, Ref. 4.7 (b) (1), pg. 228.

Texas

When children under high school age are the primary users of a building or facility, such as an elementary or middle school, mounting heights of various elements, fixtures and equipment shall be adjusted to meet the needs of the age group that the facility is to serve. Maximum heights of drinking fountains from floor to spouts shall be 32" for ages 5-11 and 34" for ages 11-15.

Spout Location

UFAS (4.15.3 Spout Location)

The spouts of drinking fountains and water coolers shall be at the front of the unit and shall direct the water flow in a trajectory that is parallel or nearly parallel to the front of the unit. The spout shall provide a flow of water at least 4" (100 mm) high so as to allow the insertion of a cup or glass under the flow of water.

Florida Children's Standards (9.1.3 Spout Location)

The spouts of drinking fountains and water coolers shall be at the front of the unit and shall direct the water flow in a trajectory that is parallel or nearly parallel to the front of the unit. The spout shall provide a flow of water at least 4" high so as to allow the insertion of a cup or glass under the flow of water.

Controls

UFAS (4.15.4 Controls)
Controls shall comply with 4.27.4. Unit controls shall be front mounted or side mounted near the front edge.

Florida Children's Standards (9.1.4 Controls)
Controls shall be blade-type handles or protruding push bars mounted on the front or each side of the fountain and located at or near the front edge of the fountain.

Clearances

North Carolina Code
For fully cantilevered drinking fountains/water coolers: the clear knee space shall be 24in from the finished floor to the underside of the unit. Appendix A-13, Ref. 4.7 (b) (2), pg. 228.

Controls and Operating Mechanisms

Summary

Table 19 summarizes the quantitative requirements for various aspects of controls and operating mechanisms (for children) as specified by the eight sources plus the UFAS.

Table 19
Controls & Operating Mechanisms

		UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.27.2 Clear Floor Space		30" X 48"		36" X 48"							
4.27.3 Height	AFF	48" - 54" 9" - 15" mi	36" max 20" min	36" max *		36" max **	40" max	40"		42" - 51"	varies by age and approach

* Except thermostats and fire alarms at 54" min and electrical receptacles mount no lower then 24" AFF.

** Outlets minimum height 15" AFF.

Comments related to Table 19

Most of the sources specify a lower maximum height for controls and operating mechanism and two specify a minimum height. The maximum height ranges from 36in to 51in. Minimum height is 20in specified by the ATBCB supplement which is greater than the 9in-15in minimum specified by the UFAS.

Florida specifies a larger width for the clear floor space than the UFAS (36in vs 30in).

Background Specifications for Controls and Operating Mechanisms

General

UFAS (4.27.1 General)
Controls and operating mechanisms required to be accessible by 4.1 shall comply with 4.27.

Clear Floor Space

UFAS (4.27.2 Clear Floor Space)
Clear floor space complying with 4.2.4 that allows a forward or a parallel approach by a person using a wheelchair shall be provided at controls, dispensers, receptacles, and other operable equipment.

Florida Children's Standards (9.2.2 Clear Floor Space)
Controls, dispensers, receptacles and other operable equipment shall have a minimum clear floor space of 36in X 48in that allows a forward or a side approach by a child using a wheelchair. Clear floor space for wheelchairs may be part of the knee space required under some objects. (Fig. 9.5, pg. 136.)

Guidelines:

Operating controls such as light switches or window and drapery hardware should not be made inaccessible to wheelchairs or other handicapped children placing them in corners or behind counters that force an awkward forward reach.

Standards and guidelines on type and location for a variety of controls can be found in the sections on specific areas such as classrooms and therapy areas.

Height

UFAS (4.27.3 Height)
The highest operable part of all controls, dispensers, receptacles, and other operable equipment shall be placed within at least one

of the reach ranges specified in 4.2.5 and 4.2.6. Except where the use of special equipment dictates otherwise, electrical and communications system receptacles on walls shall be mounted no less than 15in (380mm) above the floor.

ATBCB Children's Recommendations for Elementary Schools (1986)

UFAS 4.27.3 Height. All provisions apply with the following addition:
The highest operable part of all controls, dispensers, receptacles, and other operable equipment used by children shall be placed no higher than 36in (915mm) and no lower than 20in (510mm) above the finished floor.

Florida Children's Standards (9.2.3 Height)

The highest operable part of all controls, dispensers, receptacles, and other operable equipment shall be placed at a maximum height of 36in except fire alarms and thermostats, which shall be placed at a minimum height of 54in. Except where the use of special equipment dictates otherwise, electrical and audiovisual receptacles on walls shall be mounted no less than 24in above the floor. (Fig. 9.6, pg. 137.)

Illinois

In public facilities which primarily serve children the following dimensions and accessories may be adjusted to suit the age of the children to be accommodated in the facility. Suggested height of controls, receptacles, and dispensers is 3ft4in above the finished floor.

California

Where facilities are to be used solely by small children, the specific heights may be adjusted to meet their accessibility needs. If facilities are intended for use specifically for students which may include disabled users under 12 years of age, maximum height of controls, receptacles and dispensers shall be 3ft4in from center of operable part to the floor.

North Carolina Code

All controls and operating mechanisms shall not be mounted higher than 36in above the finished floor or ground level. Appendix A-15, Ref. 4.10, pg. 230. Power outlets shall be mounted no less than 15in from the finished floor.

Flush controls (whether manual or automatic) shall not be higher than 32in above the finished floor. Appendix A-10, Ref. 4.6.6 (c), pg. 225.

Texas

When children under high school age are the primary users of a building or facility, such as an elementary or middle school, mounting heights of various elements, fixtures and equipment shall be adjusted to meet the needs of the age group that the facility is to serve. For frontal approaches to switches and controls, maximum heights from the floor surface shall be 42in for ages 5-11 and 45in for ages 11-15. For side approaches, maximum heights shall be 48in for ages 5-11 and 51in for ages 11-15.

Operation

UFAS (4.27.4 Operation)

Controls and operating mechanisms shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate controls shall be no greater than 5 lbf (2.2 N).

Florida Children's Standards (9.2.4 Operation)

Controls and operating mechanisms shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate controls shall be no greater than 5 pounds force.

Alarms

Summary

Table 20 summarizes the quantitative requirements for various aspects of alarms (for children) as specified by the eight sources plus the UFAS.

Table 20: Alarms

Table 20
Alarms

	UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.28.2 Audible Alarms Sound Level	15 db over ambient or 5 db over max sound for 30 secs		15 db over ambient or 5 db over max sound for 30 secs							
Maximum Sound Level	120 db		120 db							
4.28.3 Visual Alarms Flashing Frequency	< 5 Hz		approx 1 Hz							

Comments related to Table 20

Florida matches the UFAS requirements except for the frequency of the visual alarms.

Background Specifications for Alarms

Audible Alarms

UFAS (4.28.2 Audible Alarms)
If provided, audible emergency alarms shall produce a sound that exceeds the prevailing equivalent sound level in the room or space by at least 15 decibels or exceeds any maximum sound level with a duration of 30 seconds by 5 decibels, whichever is louder. Sound levels for alarm signals shall not exceed 120 decibels.

Florida Children's Standards (9.3.2 Audible Alarms)
Audible emergency alarms shall produce a sound that exceeds the prevailing equivalent sound level in the room or space by at least 15 decibels or exceeds any maximum sound level with a duration of 30 seconds by 5 decibels, whichever is louder. Sound levels for alarm signals shall not exceed 120 decibels.

> Guidelines:
>
> Emergency signals should employ a decibel and frequency range that can attract the attention of children who have a partial hearing loss. High decibel systems can be upsetting to many handicapped children. Preferred systems might be a lower decibel, pulsating frequency or a low-decibel signal in conjunction with an automatic vocal command system.

Visual Alarms

UFAS (4.28.3 Visual Alarms)
If provided, electrically powered internally illuminated emergency exit signs shall flash as a visual emergency alarm in conjunction with audible emergency alarms. The flashing frequency of visual alarm devices shall be less than 5 Hz. If such alarms use electricity from the building as a power source, then they shall be installed on the same system as the audible emergency alarms. EXCEPTIONS: (1) Visual alarm devices that are mounted adjacent to emergency exit signs may be used in lieu of flashing exit signs. (2) Specialized systems utilizing advanced technology may be substituted for the visual systems specified above if equivalent protection is afforded handicapped users of the building or facility.

Florida Children's Standards (9.3.3 Visual Alarms)
Visual alarms shall be flashing lights arranged to flash in conjunction with audible emergency alarms. Flashing frequency shall be approximately 1 Hz. Specialized systems using advanced technology may be substituted if equivalent protection is afforded handicapped users of the building or facility.

Guidelines:

The hearing-impaired child may have difficulty distinguishing an audible alarm, particularly during a sleeping period, so a bright, pulsating, intense light should be employed. The pulsation frequency should be researched so as not to invoke epileptic seizures in some individuals. Colored lights might also be employed to attract greater attention to an emergency situation.

Auxiliary Alarms

UFAS (4.28.4 Auxiliary Alarms)
Accessible sleeping accommodations shall have a visual alarm connected to the building emergency alarm system or shall have a standard 110-volt electrical receptacle into which such an alarm could be connected. Instructions for use of the auxiliary alarm or connection shall be provided.

Florida Children's Standards (9.3.4 Auxiliary Alarms)
Sensory alarms provided for persons with hearing impairments shall be connected to the building emergency system or there shall be a standard 110-volt electrical receptacle into which an alarm unit can be connected to be activated by the building alarm system. Instructions for the use of the auxiliary alarm or connections shall be provided.

Public Telephones

Summary

Table 21 summarizes the quantitative requirements for various aspects of public telephones (for children) as specified by the eight sources plus UFAS.

Table 21
Public Telephones

UFAS Reference	UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
4.31.2 Clear Floor Space	30" X 48" min		30" X 48" min							front or side approach
4.31.3 Mounting Height AFF	top ≤ 48" - 54"	36" max	36" max			44" max			42" - 51"	operating mechanisms
4.31.8 Cord Length	29" min		36" min							

Comments related to Table 21

Florida and the ATBCB supplement specifies a maximum height of 36in for operating mechanisms instead of the 48in-54in specified by the UFAS. California has a 44in maximum height and Texas a range of 42in to 51in height for operating mechanisms.

Background Specifications for Public Telephones

General

UFAS (4.31.1 General)

Public telephones required to be accessible by 4.1 shall comply with 4.31.

Clear Floor or Ground Space

UFAS (4.31.2 Clear Floor or Ground Space)

A clear floor or ground space at least 30in by 48in (760mm by 1220mm) that allows either a forward or parallel approach by a person using a wheelchair shall be provided at telephones (see Fig. 44). The clear floor or ground space shall comply with 4.2.4. Bases, enclosures, and fixed seats shall not impede approaches to telephones by people who use wheelchairs.

Florida Children's Standards (9.4.2 Clear Floor or Ground Space)

Clear floor or ground spaces at each accessible public telephone are indicated in Fig. 9.7 and shall allow a parallel approach by a child using a wheelchair. (Fig. 9.7) The required clear space shall not be restricted by bases, enclosures, and fixed seats. Public telephones and related equipment shall comply with Section 3.19, Protruding Objects.

Guidelines:

Telephone enclosures mounted on centered pedestals or bases can impede a forward approach by interfering with the footrest on the wheelchair. The forward approach is not recommended for children.

Minimum Number. If public telephones are provided, at least one on each floor shall be accessible to handicapped children.

A conflict exists between the 27 inches needed for knee clearance for a forward approach and the requirements for protruding objects. The wall mounted unit will need additional detailing so either it can be detected by the cane of a child or it cannot protrude into the circulation path more than 4 inches.

Mounting Height

UFAS (4.31.3 Mounting Height)
The highest operable part of the telephone shall be within the reach ranges specified in 4.2.5 or 4.2.6.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 4.31.3 Telephones - Mounting Height. All provisions apply with the following addition:
If intended for use by children, the highest operable part of the telephone shall be 36in (915mm) above the finished floor. Telephones used by children shall be installed in accordance with modified Figure 44.

Florida Children's Standards (9.4.3 Mounting Height)
If intended for use by children, the highest operable part of the telephone shall be a maximum of 36in above the finished floor. (Fig. 9.7, pg. 140.)

California
Where facilities are to be used solely be small children, the specific heights may be adjusted to meet their accessibility needs. If facilities are intended for use specifically for students which may include disabled users under 12 years of age, heights of telephones to highest operable mechanisms shall be 3ft8in from the floor surface.

Texas
When children under high school age are the primary users of a building or facility, such as an elementary or middle school, mounting heights of various elements, fixtures and equipment shall be adjusted to meet the needs of the age group that the facility is to serve. For front approaches to telephones, maximum heights from floor surface to tops of devices shall be 42in for ages 5-11 and 45in for ages 11-15. For side approaches, maximum heights shall be 48in for ages 5-11 and 51in for ages 11-15.

Protruding Objects

UFAS (4.31.4 Protruding Objects)
Telephones shall comply with 4.4.

Florida Children's Standards

Editors note: the following is excerpted from 9.4.2 Clear Floor or Ground Space

Guidelines:
A conflict exists between the 27 inches needed for knee clearance for a forward approach and the requirements for protruding objects. The wall mounted unit will need additional detailing so either it can be detected by the cane of a child or it cannot protrude into the circulation path more than 4 inches.

Equipment for Hearing-Impaired People

UFAS (4.31.5 Equipment for Hearing Impaired People)
Telephones shall be equipped with a receiver that generates a magnetic field in the area of the receiver cap. Volume controls shall be provided in accordance with 4.1.2.

Florida Children's Standards (9.4.5 Equipment for Hearing-Impaired People)
Telephones shall be equipped with a receiver that generates a magnetic field in the area of the receiver cap. Volume control shall be available in any building or facility containing a bank of telephones with an accessible telephone. If a telecommunications device for the deaf (TDD) or similar equipment is provided, the location of such equipment shall be indicated by strategically placed signage.

Controls

UFAS (4.31.6 Controls)
Telephones shall have pushbutton controls where service for such equipment is available.

Florida Children's Standards (9.4.6 Controls)
Accessible telephones shall have pushbutton controls where service for such equipment is available.

Telephone Directories

UFAS (4.31.7 Telephone Books)
Telephone books, if provided, shall be located in a position that complies with the reach ranges specified in 4.2.5 and 4.2.6.

Cord Length

UFAS (4.31.8 Cord Length)
The cord from the telephone to the handset shall be at least 29in (735mm) long.

Florida Children's Standards (9.4.8 Cord Length)
Accessible telephones shall be equipped with a minimum handset cord length shall be 36in.

Restaurants and Cafeterias

Summary

Table 22 summarizes the quantitative requirements for various aspects of restaurants and cafeterias (for children) as specified by the eight sources plus the UFAS.

Table 22
Restaurants & Cafeterias

			UFAS	ATBCB Supp.	Florida Std.	NC DOE	NC Code	CA Code	IL Code	MI Guide	TX Code	Comments
	Food Service Lines	AFF										
5.2	Clear Width		36" min 42" preferred		44" min							
5.2	Tray Slides	AFF	34" max	30" max	30" max		30" max					
5.2	Self Service Height	AFF AFF	54" max 9" min	36" max	30" max		36" max					
5.2	Forward/Side Reach			12" max	12" max		15" max					
	Knee Space Under Tray Slide				27" min							

Comments related to Table 22

Florida, the ATBCB supplement and the North Carolina code have specifications that differ from the UFAS. All three specify the maximum height for tray slides at 30in. The maximum height for self service ranges from 30in to 36in and the forward and side reach ranges from 12in to 15in. Florida specifies that the width for aisles at food service areas is larger than the UFAS (44in vs 36in). Only Florida specifies a knee space under the tray slide.

Background Specifications for Restaurants and Cafeterias

General

UFAS (5.1 General)
In addition to the requirements of 4.1 and 4.33, the design of at least 5 percent of all fixed seating or tables in a restaurant or cafeteria shall comply with 4.32. Access aisles between tables shall comply with 4.3. Where practical, accessible tables should be distributed throughout the space or facility. In restaurants or cafeterias where there are mezzanine levels, loggias, or raised platforms, accessibility to all such spaces is not required provided that the same services and decorative character are provided in spaces located on accessible routes.

ATBCB Children's Recommendations for Elementary Schools (1986)
UFAS 5.1 (Restaurants and Cafeterias - General). All provisions apply with the following additions:
In additions to the requirements of UFAS 4.1 through 4.33, (Accessible Elements and Spaces: Scope and Technical Requirements), the design of at least 5 percent of all fixed seating or tables in a cafeteria used by children shall comply with 4.32 (Seating, Tables and Work Surfaces), as supplemented by these recommendations and the recommendations listed below. Access aisles between tables shall comply with 4.3. (Accessible Routes). Where practical, accessible tables should be distributed throughout the space or facility. Accessible toilet rooms should be provided near the cafeteria and shall comply with UFAS 4.22 (Toilet Rooms) or 4.23 (Bathrooms, Bathing Facilities and Shower Rooms) and the recommendations for water closets, urinals, lavatories and mirrors, shower stalls and sinks listed in this document.

Food Service Lines

UFAS (5.2 Food Service Lines)

Food service lines shall have a minimum clear width of 36" (915 mm), with a preferred clear width of 42" (1065 mm) where passage of stopped wheelchairs by pedestrians is desired. Tray slides shall be mounted no higher than 34" (865 mm) above the floor. If self-service shelves are provided, a reasonable portion must be within the ranges shown in Fig. 53.

ATBCB Children's Recommendations for Elementary Schools (1986)

UFAS 5.2 (Restaurants and Cafeterias - Food Service Lines). All provisions apply with the following additions:
Tray slides used by children shall be mounted no higher than 30" (760 mm) above the floor. The maximum forward/side reach by children for food service is 12" (305 mm). If self-service shelves are provided, a reasonable portion must be within the ranges shown in modified Figure 53.

Florida Children's Standards (5.3.2 Food Service Lines)

Food service lines shall meet the following criteria. (Fig. 5.5)

(1) Food service lines shall have a minimum clear width of 44 inches between the tray slides and aisle control bars.

(2) Tray slides shall be mounted no higher than 30 inches above the floor.

(3) If self-service shelves are provided, a reasonable portion must be within a reach distance of 12 inches.

North Carolina Code

Tray slides shall be mounted no higher than 30" above the finished floor. The horizontal clear side reach measured from the forward edge of the fixed tray slide shall not be greater than 15". Note: The maximum height of any self-service tableware, dishware, napkin dispenser, beverage dispensing device, etc. shall not be greater than 36" above the finished floor. Appendix A-17, Ref. 7.2 (h), pg. 232.

Tableware Areas

UFAS (5.3 Tableware Areas)

Install tableware, dishware, condiment, food and beverage display shelves, and dispensing devices in compliance with 4.2 (see Fig. 54).

ATBCB Children's Recommendations for Elementary Schools (1986).
UFAS 5.3 (Tableware Areas). All provisions apply with the following additions:
Install tableware, dishware, condiment, food and beverage display shelves, and dispensing devices used by children in compliance with 4.2 (Space Allowances and Reaching Ranges) as supplemented by these recommendations, shown in modified Figure 53.

Vending Machines

UFAS (5.4 Vending Machines)
Install vending machines in compliance with 4.27.

ATBCB Children's Recommendations for Elementary Schools (1986).
UFAS 5.4 (Vending Machines). All provisions apply with the following additions:
Install vending machines used by children in compliance with 4.27 (Controls and Operating Mechanisms) as supplemented by these recommendations.

Locker Rooms and Gymnasiums

Summary

No table is provided for this section due to limited specifications.

Background Specifications for Locker Rooms and Gymnasiums

Lockers

ATBCB Children's Recommendations for Elementary Schools (1986)
Supplementary Recommendations:
Provide an accessible route from locker to toilets, gymnasiums and athletic fields. In addition to the requirements in UFAS 4.1 to 4.33 (Accessible Elements and Spaces: Scope and Technical Requirements), as supplemented by these recommendations, locker rooms and gymnasium lockers used by children should have the following: Heights and Clearances - Locker shelves and hooks should be a maximum of 36in (915mm) above the floor. Provide larger lockers with minimum opening of 28in (710mm) if lockers are over 12in (305mm) deep.

Dwelling Units

Summary

No table is presented for this section. The following is provided as background information.

Background Specifications for Dwelling Units

Minimum Requirements

UFAS (4.34.2 Minimum Requirements)
An accessible dwelling unit shall be on an accessible route. An accessible dwelling unit shall have the following accessible elements and spaces as a minimum: (1) Common spaces and facilities serving individual accessible dwelling units (for example, entry walks, trash disposal facilities and mail boxes) shall comply with 4.2 through 4.33. (2) Accessible spaces shall have maneuvering space complying with 4.2.2 and 4.2.3 and surfaces complying with 4.5. (3) At least one accessible route complying with 4.3 shall connect the accessible entrances with all accessible spaces and elements within the dwelling units. (4)See 4.1.1 (5) (d)–Parking. (5) Removed and reserved. (6) Doors to and in accessible spaces that are intended for passage shall comply with 4.13, except that the provisions of 4.13.9 apply only to the doors at accessible entrances to the unit itself. (7) At least one accessible entrance to the dwelling unit shall comply with 4.14. (8) Storage in accessible spaces in dwelling units, including cabinets, shelves, closets, and drawers shall comply with 4.25. (9) All controls in accessible spaces shall comply with 4.27. Those portions of heating, ventilating and air conditioning equipment requiring regular, periodic maintenance and adjustment by the resident of a dwelling shall be accessible to people in wheelchairs. If air distribution registers must be placed in or close to ceilings for proper air circulation, this specification shall not apply to the registers. (10) Emergency alarms as required by 4.1 and complying with 4.28.4 shall be provided in the dwelling unit. (11) Removed and reserved. (12) At least one full bathroom shall comply with 4.34.5. A full bathroom shall include a water closet, a lavatory and a bathtub or shower. (13) The kitchen shall comply with 4.34.6. (14) If laundry facilities are provided, they shall comply with 4.34.7. (15) The following spaces shall be accessible and shall be on an accessible route: (a) The living area. (b) The dining area. (c) The sleeping area, or the bedroom in one-bedroom dwelling units, or at least two bedrooms or sleeping spaces in dwelling units with two or more bedrooms. (d) Patios, terraces, balconies, carports, and garages, if provided with the dwelling unit.

Adaptability

UFAS (4.34.3 Adaptability)
The specifications for 4.34.5 and 4.34.6 include the concept of adaptability. Accessible dwelling units may be designed for either permanent accessibility or adaptability.

Consumer Information

UFAS (4.34.4 Consumer Information)
To ensure that the existence of adaptable features will be known to the owner or occupant of a dwelling, the following consumer information shall be provided in each adaptable dwelling unit available for occupancy: (1) Notification of the alternate heights available for the kitchen counter and sink, and the existence of removable cabinets and bases, if provided, under counters, sinks and lavatories. (2) Notification of the provisions for the installation of grab bars at toilets, bathtubs, and showers. (3) Notification that the dwelling unit is equipped to have a visual emergency alarm installed. (4) Identification of the location where information and instructions are available for changing the height of counters, removing cabinets and bases, installing a visual emergency alarm system, and installing grab bars. (5) Notification that the dwelling unit has been designed in accordance with this Uniform Federal Accessibility Standards.

In addition, the parties who will be responsible for making adaptations shall be provided with the following information:

(1) Instructions for adjusting or replacing kitchen counter and sink heights and for removing cabinets. (2) A scale drawing showing methods and locations for the installation of grab bars. (3) A scale drawing showing the location of adjustable or replaceable counter areas and removable cabinets. (4) Identification of the location of any equipment and parts required for adjusting or replacing counter tops, cabinets and sinks. (5) Instructions for installing a visual emergency alarm system, if the dwelling unit is equipped for such an installation.

Bathrooms

UFAS (4.34.5 Bathrooms)
Accessible or adaptable bathrooms shall be on an accessible route and shall comply with the requirements of 4.34.5.

Bathroom Doors

UFAS (4.34.5.1 Bathrooms, Doors)
Doors shall not swing into the clear floor space required for any fixture.

Water Closets

UFAS (4.34.5.2 Bathrooms, Water Closets)

(1) Clear floor space at the water closet shall be as shown in Fig. 47 (a). The water closet may be located with the clear area at either the right or left side of the toilet. (2) The height of the water closet shall be at least 15in (380mm) and no more than 19in (485mm), measured to the top of the toilet seat. (3) Structural reinforcement or other provisions that will allow installation of grab bars shall be provided in the locations shown in Fig. 47 (b). If provided, grab bars shall be installed as shown in Fig. 29, and shall comply with 4.26. (4) The toilet paper dispenser shall be installed within reach as shown in Fig. 47(b).

Lavatories, Mirrors and Medicine Cabinets

UFAS (4.34.5.3 Lavatory, Mirrors and Medicine Cabinets)

(1) Lavatories and mirrors shall comply with 4.22.6. (2) If a cabinet is provided under the lavatory in adaptable bathrooms, then it shall be removable to provide the clearances specified in 4.22.6. (3) If a medicine cabinet is provided above the lavatory, then the bottom of the medicine cabinet shall be located with a usable shelf no higher than 44in (1120mm) above the floor.

Bathtubs

UFAS (4.34.5.4 Bathrooms, Bathtubs)

If a bathtub is provided, then it shall have the following features: (1) Floor space. Clear floor space at bathtubs shall be as shown in Fig. 33. (2) Seat. An in-tub seat or a seat at the head end of the tub shall be provided as shown in Fig. 33 and 34. The structural strength of seats and their attachments shall comply with 4.26.3. Seats shall be mounted securely and shall not slip during use. (3) Grab Bars. Structural reinforcement or other provisions that will allow installation of grab bars shall be provided in the locations shown in Fig. 48. If provided, grab bars shall be installed as shown in Fig. 34 and shall comply with 4.26. (4) Controls. Faucets and other controls shall be located as shown in Fig. 34 and shall comply with 4.27.4. (5) Shower unit. A shower spray unit with a hose at least 60in (1525mm) long that can be used as a fixed shower head or as a hand-held shower shall be provided.

Showers

UFAS (4.34.5.5 Bathrooms, Showers)

If a shower is provided, it shall have the following features: (1) Size and clearances. Shower stall size and clear floor space shall comply with either Fig. 35 (a) or (b). The shower stall in Fig. 35 (a) shall be 36in by 36in (915mm by 915mm). The shower stall *in Fig. 35 (b) will fit into the same space as a standard 60in (1525mm) long bathtub. (2) Seat. A seat shall be provided in the shower stall in Fig. 35 (a) as shown in Fig. 36. The seat shall be 17in to 19in (430mm to 485mm) high measured from the bathroom floor and shall extend the full depth of the stall. The seat shall be on the wall opposite the controls. The structural strength of seats and their attachments shall comply with 4.26.3. Seats shall be mounted securely and shall not slip during use. (3) Grab bars. Structural reinforcement or other provisions that will allow installation of grab bars shall be provided in the locations shown in Fig. 49. If provided, grab bars shall be installed as shown in Fig. 37 and shall comply with 4.26. (4) Controls. Faucets and other controls shall be located as shown in Fig. 37 and shall comply with 4.27.4. In the shower stall in Fig. 35 (a), all controls, faucets and the shower unit shall be mounted on the side wall opposite the seat. (5) Shower unit. A shower spray unit with a hose at least 60in (1525mm) long that can be used as a fixed shower head at various heights or as a hand-held shower shall be provided.*

Bathtub and Shower Enclosures

UFAS (4.34.5.6 Bathrooms, Bathtub and Shower Enclosures)

Enclosures for bathtubs or shower stalls shall not obstruct controls or transfer from wheelchairs onto shower or bathtub seats. Enclosures on bathtubs shall not have tracks mounted on their rims.

Bathrooms - Clear Floor Space

UFAS (4.34.5.7 Bathrooms, Clear Floor Space)

Clear floor space at fixtures may overlap.

Kitchens

UFAS (4.34.6 Kitchens)

Accessible or adaptable kitchens and their components shall be on an accessible route and shall comply with the requirements of 4.34.6.

Kitchens - Clearance

UFAS (4.34.6.1 Kitchens, Clearance)

Clearances between all opposing base cabinets, counter tops, appliances, or walls shall be 40in (1015mm) minimum, except in U-shaped kitchens, where such clearance shall be 60in (1525mm) minimum.

Kitchens - Clear Floor Space

UFAS (4.34.6.2 Kitchens, Clear Floor Space)

A clear floor space at least 30in by 48in (760mm by 1220mm) complying with 4.2.4 that allows either a forward or a parallel approach by a person in a wheelchair shall be provided at all appliances in the kitchen, including the range or cooktop, oven, refrigerator/freezer, dishwasher, and trash compactor. Laundry equipment located in the kitchen shall comply with 4.34.7.

Kitchens - Controls

UFAS (4.34.6.3 Kitchens, Controls)

All controls in kitchens shall comply with 4.27.

Kitchens - Work Surfaces

UFAS (4.34.6.4 Kitchens, Work Surfaces)

At least one 30in (760mm) section of counter shall provide a work surface that complies with the following requirements (see Fig. 50): (1) The counter shall be mounted at a maximum height of 34in (865mm) above the floor, measured from the floor to the top of the counter surface, or shall be adjustable or replaceable as a unit to provide alternative heights of 28in, 32in and 36in (710mm, 815mm and 915mm), measured from the top of the counter surface. (2) Base cabinets, if provided, shall be removable under the full 30in (760mm) minimum frontage of the counter. The finished floor shall extend under the counter to the wall. (3) Counter thickness and supporting structure shall be 2in (50mm) maximum over the required clear area. (4) A clear floor space 30in by 48in (760mm by 1220mm) shall allow a forward approach to the counter. Nineteen inches (485mm) maximum of the clear floor space may extend underneath the counter. The knee space shall have a minimum clear width of 30in (760mm) and a minimum clear depth of 19in (485mm). (5) There shall be no sharp or abrasive surfaces under such counters.

Kitchens - Sinks

UFAS (4.34.6.5 Kitchens, Sink)

The sink and surrounding counter shall comply with following requirements (see Fig. 51): (1) The sink and surrounding counter shall be mounted at a maximum height of 34in (865mm) above the floor, measured from the floor to the top of the counter surface, or shall be adjustable or replaceable as a unit to provide alternative heights of 28in, 32in and 36in (710mm, 815mm and 915mm), measured from the floor to the top of the counter surface or sink rim. The total width of sink and counter area shall be 30in (760mm). (2) Rough-in plumbing shall be located to accept connections of supply and drain pipes for sinks mounted at the height *of 28in (710mm). (3) The depth of a sink bowl shall be no greater than 6.5in (165)mm). Only one bowl of double- or triple-bowl sinks needs to meet this requirement. (4) Faucets shall comply with 4.27.4. Lever-operated or push-type mechanisms are two acceptable designs. (5) Base cabinets, if provided, shall be removable under the full 30in (760mm) minimum frontage of the sink and surrounding counter. The finished flooring shall extend under the counter to the wall. (6) Counter thickness and supporting structure shall be 2in (50mm) maximum over the required clear space. (7) A clear floor space 30in by 48in (760mm by 1220mm) shall allow forward approach to the sink. Nineteen inches (485mm) maximum of the clear floor space may extend underneath the sink. The knee space shall have a clear width of 30in (760mm) and a clear depth of 19in (485mm). (8) There shall be no sharp or abrasive surfaces under sinks. Hot water and drain pipes under sinks shall be insulated or otherwise covered.*

Ranges and Cooktops

UFAS (4.34.6.6 Kitchen, Ranges and Cooktops)
Ranges and cooktops shall comply with 4.34.6.2 and 4.34.6.3. If ovens or cooktops have knee spaces underneath, then they shall be insulated or otherwise protected on the exposed contact surfaces to prevent burns, abrasions, or electrical shock. The clear floor space may overlap the knee space, if provided, by 19in (485mm) maximum. The location of controls for ranges and cooktops shall not require reaching across burners.

Ovens

UFAS (4.34.6.7 Kitchens, Ovens)
Ovens shall comply with 4.34.6.2 and 4.34.6.3. Ovens shall be of the self-cleaning type or be located adjacent to an adjustable height counter with knee space below (see Fig. 52). For side-opening ovens, the door latch side shall be next to the open counter space, and there shall be a pull-out shelf under the oven extending the full width of the oven and pulling out not less than 10in (255mm) when fully extended. Ovens shall have controls on front panels; they may be located on either side of the door.

Refrigerator/Freezers

UFAS (4.34.6.8 Kitchens, Refrigerator/Freezers)
Refrigerator/freezers shall comply with 4.34.6.3. Provision shall be made for refrigerators which are: (1) Of the vertical side-by-side refrigerator/freezer type; or (2) Of the over-and-under type and meet the following requirements: (a) Have at least 50 percent of the freezer space below 54in (1370mm) above the floor. (b) Have 100 percent of the refrigerator space and controls below 54in (1370mm).

Freezers with less than 100 percent of the storage volume within the limits specified in 4.2.5 or 4.2.6 shall be the self-defrosting type.

Dishwashers

UFAS (4.34.6.9 Kitchens, Dishwashers)
Dishwasher shall comply with 4.34.6.2 and 4.34.6.3. Dishwashers shall have all rack space accessible from the front of the machine for loading and unloading dishes.

Kitchens - Storage

UFAS (4.34.6.10 Kitchens, Storage)
Cabinets, drawers, and shelf areas shall comply with 4.25 and shall have the following features: (1) Maximum height shall be 48in (1220mm) for at least one shelf of all cabinets and storage shelves mounted above work counters (see Fig. 50). (2) Door pulls or handles for wall cabinets shall be mounted as close to the bottom of the cabinet doors as possible. Door pulls or handles for base cabinets shall be mounted as close to the top of cabinet doors as possible.

Laundry Facilities

UFAS (4.34.7 Laundry Facilities)
If laundry equipment is provided within individual accessible dwelling units, or if separate laundry facilities serve one or more accessible dwelling units, then they shall meet the requirements of 4.34.7.1 through 4.34.7.3.

Laundry Facilities - Location

UFAS (4.34.7.1 Laundry Facilities, Location)
Laundry facilities and laundry equipment shall be on an accessible route.

Washing Machines and Clothes Dryers

UFAS (4.34.7.2 Washing Machines and Clothes Dryers)
Washing machines and clothes dryers in common use laundry rooms shall be front loading.

Laundry Facilities - Controls

UFAS (4.34.7.3 Laundry Facilities, Controls)
Laundry equipment shall comply with 4.27.

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CHAPTER 2

Review of ergonomic studies of children's environments and review of literature on products and technologies.

PREFACE

This chapter reports on ergonomic studies of disabled children research and new products and technologies such as assistive devices and adaptive technologies that are intended to be used by disabled children and that might impact the development of accessibility standards for children.

Ergonomic Studies of Children's Environments

The ergonomic research literature related to the physical limitations of children with disabilities that affect their ability to access the physical features of their everyday environment. In this regard only two items of relevant research were identified. One was the substantial 1988 study by Australians Bails and Seeger: *Ergonomic Design for Physically Disabled Children (parts I and II)*. In this work, the physical abilities of able-bodied and disabled children aged 3 - 18 years were assessed in a variety of task-oriented settings. The second ergonomic study was by Steinfeld and Czaja (1980).

This report is intended to be a working document that identifies the differences and similarities, as well as the gaps that exist in the current knowledge base in these areas. As such, the findings of this task are presented as comparative tables based on those completed in the previous task.

The comparative tables for ergonomic data follow, beginning on the next page.

Summary Table
Balls 1988 & Steinfeld 1980

UFAS	Reference	UFAS	ATBCB Rev.	Steinfeld Data	Balls Data	Comments
4.2.5	Forward Reach AFF	48"	36"	36"	31.69"	
4.2.6	Side Reach AFF	54"	36"		26.77" max 1.29" min	
4.13.11	Push-Pull Force †	5 lb interior			.65 - 5.51 lbs ††	
	two handed pull			5.53 lb max		
	one hand pull			6.84 lb max		
	two hand push			5.54 lb max		
	one hand push			6.08 lb max		
4.16.4	Grab bar height at toilets AFF	33"-36"	25"-27"	21"-27" *		
4.17.3	Recommended toilet stall width	36",48",60"		60" **		
4.16.3	Toilet seat height AFF	17"-19"	15"-17"	14"-22"	11.4"-19.3" ****	
4.9.4	Handrail height at stairs					
	Single handrail AFF	30"-34"	26"-28"	26"-28"	33.86"- 38.39"	
	Double handrail AFF			26" & 30"		
4.8.2	Max. Ramp slope	1:12	1:20***	1:20	1:14	
	Max. Distance between rest areas on ramps			200'		

† Force as applied to door hardware

†† low value for children with a disability, high value for able-bodied children

* 23" AFF was optimal for most ambulatory subjects, two subjects preferred 26" AFF

** wheelchair users in elementary schools are likely to receive assistance to transfer to the toilet.

*** Pre-Kindergarten for 1 Route

**** no data for wheelchair users

Table 1
Accessible Route

Bails 1988

UFAS Reference	UFAS	Ages 3 - 6.5	Ages 6.5-10.5	Ages 10.5 - 14.5	Ages 14.5 - 18	Comments
Length Between Rest Areas						
1:22 Gradient Ramps		14' (4.2 m)	16' (5 m)	21' (6.5 m)	29' (9 m)	
1:17 Gradient Ramps		11' (3.5 m)	13' (4 m)	16' (5 m)	23' (7 m)	
1:14 Gradient Ramps		7' (2.2 m)	10' (3 m)	13' (4 m)	16' (5 m)	

Table 2
Ramps
Bails 1988

UFAS Reference	UFAS	Ages 3 - 6.5	Ages 6.5 - 10.5	Ages 10.5 - 14.5	Ages 14.5 - 18	Comments
4.8.5 Railing Height	30" - 34" AFF					
Able-Bodied		36.02" (915 mm)	36.42" (925 mm)	37.01" (940 mm)	37.20" (945 mm)	gradients 1:22 up to and
Ambulant Disabled		34.05" (865 mm)	35.43" (900 mm)	36.61" (930 mm)	37.20" (945 mm)	including 1:14
4.8.2 Maximum Slope	1:12	1:14	1:14	1:14	1:14	maximum slope tested

Table 3
Stairs

Bails 1988

UFAS Reference		UFAS	Ages 3 - 6.5	Ages 6.5-10.5	Ages 10.5 - 14.5	Ages 14.5 - 18	Comments
	Maximum Single Step Rise						
	Able-Bodied		9.45" (240 mm)	9.45" (240 mm)	9.45" (240 mm)	9.45" (240 mm)	
	Ambulant Disabled						
	Mobility aids		7.87" (200 mm)	0	9.45" (240 mm)	9.45" (240 mm)	crutches, canes, or walkers also includes subjects with no visible mobility aids
	No visible mobility aids		8.66" (220 mm)	9.45" (240 mm)	9.45" (240 mm)	9.45" (240 mm)	
	Manually-powered Wheelchairs		0	0	0	0	cannot achieve access
	Electrically-powered wheelchairs		0	0	0	0	cannot achieve access
	Total Disabled Sample		0	0	0	0	80% cannot achieve access
	Handrail Height						
4.9.4	At Stairs	30" - 34" above nosing					
	Able-Bodied		36.81" (935 mm)	37.99" (965 mm)	38.39" (975 mm)	38.39" (975 mm)	
	Ambulant Disabled		33.86" (860 mm)	35.83" (910 mm)	37.99" (965 mm)	38.39" (975 mm)	
	At Landings						
	Able-Bodied		34.05" (865 mm)	35.04" (890 mm)	36.02" (915 mm)	36.22" (920 mm)	
	Ambulant Disabled		32.48" (825 mm)	33.86" (860 mm)	35.83" (910 mm)	37.20" (945 mm)	

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Table 4
Doors

Bails 1988

UFAS Reference	UFAS	Ages 3 - 6.5	Ages 6.5-10.5	Ages 10.5 - 14.5	Ages 14.5 - 18	Comments
4.13.11 Force To Open	5 lbs					
Able-Bodied		2.20 lbs	4.41 lbs	5.51 lbs	5.51 lbs	
Disabled		0.65 lbs	0.65 lbs	0.65 lbs	0.65 lbs	

Table 5
Curb Ramps

Bails 1988

UFAS Reference	UFAS	Ages 3 - 6.5	Ages 6.5-10.5	Ages 10.5 - 14.5	Ages 14.5 - 18	Comments
Gradients		1:8	1:8	1:8	1:8	total rise of 200 mm - accessible to 80% of children with disabilities

Table 6
Classrooms and Instructional Areas
Bails 1988

	UFAS	Ages 3 - 6.5	Ages 6.5 - 10.5	Ages 10.5 - 14.5	Ages 14.5 - 18	Comments
4.32.4 Tables & Work Surfaces - Height	28" - 34"					
Able-Bodied & Ambulant Disabled		23.62" (600 mm)	25.00" (635 mm)	28.35" (720 mm)	29.53" (750 mm)	Mean Preferred Height
		22.24 - 25.98	23.43 - 27.56	25.79 - 30.31	27.56 - 30.71	Range (inches)
Wheelchair Users		26.77" (680 mm)	27.56" (700 mm)	28.74" (730 mm)	30.31" (770 mm)	Mean Preferred Height
		23.62 - 30.31	24.41 - 30.71	24.41 - 33.07	26.38 - 34.25	Range (inches)
Seat Height						
Able-Bodied		12.4" (315 mm)	12.99" (330 mm)	16.34" (415 mm)	17.13" (435 mm)	Mean Preferred Height
		10.43 - 14.37	11.02 - 15.94	14.37 - 18.31	14.18 - 19.1	Range (inches)
Ambulant Disabled		11.41" (290 mm)	12.4" (315 mm)	16.14" (410 mm)	17.13" (435 mm)	Mean Preferred Height
		8.46 - 13.36	9.45 - 14.37	13.19 - 18.11	14.18 - 19.1	Range (inches)

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Table 7
Storage

Bails 1988

UFAS	Reference	UFAS	Ages 3 - 6.5	Ages 6.5-10.5	Ages 10.5 - 14.5	Ages 14.5 - 18	Comments
4.25.3	Height AFF	54" max					
	Able-Bodied		0 - 37.40"	0- 45.00"	0 - 584.33"	0 - 61.02"	No minimum gap space specified
	Disabled		5.91 - 9.84"	15.75 - 19.69"	15.75 - 18.11"	14.57 - 16.54"	Lowest range
			32.28 - 29.92"	34.65 - 31.50"	38.19 - 33.46"	39.37 - 35.43"	Highest range
			11.02 - 17.72"	12.60 - 17.72"	12.60 - 17.72"	10.63 - 17.72"	Minimum gap space

Table 8
Lavatories, Sinks & Toilets

Bails 1988

UFAS Reference		UFAS	Ages 3 - 6.5	Ages 6.5-10.5	Ages 10.5 - 14.5	Ages 14.5 - 18	Comments
	Lavatories & Sinks						
4.19.2	Height	34" max AFF					
	Able-Bodied		25.59" (650 mm)	29.92" (760 mm)	33.07" (840 mm)	33.46" (850 mm)	Mean Preferred Height
			22.64 - 29.53	26.97 - 33.86	30.12 - 37.01	30.51 - 37.40	Range (inches)
	Ambulant Disabled		25.59" (650 mm)	27.17" (690 mm)	31.89" (810 m)	33.46" (850 mm)	Mean Preferred Height
			22.64 - 29.53	24.22 - 31.11	28.94 - 35.83	30.51 - 37.40	Range (inches)
	Wheelchair Users		25.59" (650 mm)	27.17" (690 mm)	29.13" (740 mm)	29.92" (760 mm)	Mean Preferred Height
			22.64 - 28.54	24.22 - 30.12	26.18 - 32.08	26.97 - 32.87	Range (inches)
4.16.3	Toilet Seat Height	17"-19"					
	Able-Bodied		12.80" (325 mm)	14.57" (370 mm)	16.93" (430 mm)	17.32" (440 mm)	Mean Preferred Height
			11.42 - 14.77	13.00 - 14.57	15.16 - 18.50	19.29 - 15.94	Range (inches)
	Ambulant Disabled		12.80" (325 mm)	12.80" (325 mm)	16.54" (420 mm)	17.32" (440 mm)	With and without visual mobility aids - no data for wheelchair users
			11.82 - 13.78	11.62 - 13.98	15.16 - 18.11	15.35 - 19.29	

Table 9
Controls and Operating Mechanisms

Bails 1988

UFAS Reference	UFAS	Ages 3 - 6.5	Ages 6.5-10.5	Ages 10.5 - 14.5	Ages 14.5 - 18	Comments
Force to Operate a Lever						
Able-Bodied		2.55 lbs	4.68 lbs	5.11 lbs	5.74 lbs	
Disabled		2.40 lbs	2.34 lbs	3.18 lbs	4.04 lbs	
Force to Operate a Tap Handle						Capstan, winged or contoured
Able-Bodied		1.16 lbs	1.91 lbs	1.91 lbs	2.76 lbs	
Disabled		0.74 lbs	1.38 lbs	1.49 lbs	1.60 lbs	

Table 10
Operating Forces

Bails 1988

UFAS Reference		UFAS	Ages 3 - 6.5	Ages 6.5-10.5	Ages 10.5 - 14.5	Ages 14.5 - 18	Comments
	Pull Cords						
	Able-Bodied		5.73 lbs	7.94 lbs	8.81 lbs	9.26 lbs	Cords fitted w/1.18" knob
4.27.4	Disabled	5 lbf	2.20 lbs	4.86 lbs	5.28 lbs	6.61 lbs	or 3.94" ring pull
	Push Buttons						
	Protruding Button						
	Down Push						
	Able-Bodied		3.30 lbs	4.63 lbs	4.74 lbs	5.28 lbs	
4.27.4	Disabled	5 lbf	2.20 lbs	2.76 lbs	3.30 lbs	4.63 lbs	
	Horizontal Push						
	Able-Bodied		3.53 lbs	5.08 lbs	5.33 lbs	5.73 lbs	
4.27.4	Disabled	5 lbf	2.76 lbs	3.42 lbs	4.07 lbs	5.08 lbs	
	Recessed Button						
	Down Push						
	Able-Bodied		1.99 lbs	2.43 lbs	2.86 lbs	3.30 lbs	
4.27.4	Disabled	5 lbf	1.44 lbs	1.66 lbs	1.75 lbs	2.65 lbs	
	Horizontal Push						
	Able-Bodied		1.99 lbs	2.43 lbs	2.86 lbs	3.30 lbs	
4.27.4	Disabled	5 lbf	1.44 lbs	1.66 lbs	1.75 lbs	2.76 lbs	

Table 11
Limits of Reach Over and Above Surfaces

Bails 1988

UFAS Reference		UFAS	Ages 3 - 6.5	Ages 6.5-10.5	Ages 10.5 - 14.5	Ages 14.5 - 18	Comments
	Reach Over Bench Surfaces						
4.2.5	Forward	25"					
	Able-Bodied, Ambulant Disabled & Manual Wheelchair Users		11.61" (295 mm)	14.17" (360 mm)	15.75" (400 mm)	17.91" (455 mm)	
	Electric Wheelchair Users		10.83" (275 mm)	8.86" (225 mm)	9.25" (235 mm)	12.01" (305 mm)	
4.2.6	Side	24"					
	Able-Bodied, Ambulant Disabled & Manual Wheelchair Users		16.54 - 16.14" (420 - 410 mm)	16.[illegible]3 - 16.54" (430 - 420 mm)	18.70 - 18.90" (475 - 480 mm)	20.47 - 20.47" (520 - 520 mm)	Describes arc from left to right
	Electric Wheelchair Users		12.99 - 12.52" (330 - 318 mm)	10.83 - 11.02" (275 - 280 mm)	10.83 - 11.02" (275 - 280 mm)	16.73 - 16.93" (425 - 430 mm)	Describes arc from left to right
	Reach Above Bench Surfaces						
	Able-Bodied & Ambulant Disabled		12.00" (305 mm)	13.7" (348 mm)	23.82" (605 mm)	25.98" (660 mm)	
	Manual Wheelchair Users		10.24" (260 mm)	9.92" (252 mm)	20.67" (525 mm)	18.11" (460 mm)	
	Electric Wheelchair Users		8.86" (225 mm)	7.80" (198 mm)	11.02" (280 mm)	15.75" (400 mm)	

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Table12
Limits of Reach Along Walls

Bails 1988

UFAS	Reference	UFAS	Ages 3 - 6.5	Ages 6.5-10.5	Ages 10.5 - 14.5	Ages 14.5 - 18	Comments
	Reach Along a Side Wall						
4.2.6	Vertical	54" max 9" min					
	Able-Bodied		41.34" (1050 mm)	54.33" (1380 mm)	58.86" (1495 mm)	59.64" (1515 mm)	
	Ambulatory Disabled		38.98" (990 mm)	46.06" (1170 mm)	58.86" (1495 mm)	59.64" (1515 mm)	
	Manual Wheelchair Users		38.98" (990 mm)	40.55" (1030 mm)	46.06" (1170 mm)	43.31" (1100 mm)	
	Electric Wheelchair Users		38.98" (990 mm)	40.55" (1030 mm)	41.73" (1060 mm)	47.24" (1200 mm)	
	Horizontal						
	Able-Bodied		21.65" (550 mm)	26.77" (680 mm)	24.02" (610 mm)	26.77" (680 mm)	
	Ambulatory Disabled		12.91" (328 mm)	21.46" (545 mm)	24.02" (610 mm)	26.77" (680 mm)	
	Manual Wheelchair Users		12.91" (328 mm)	19.57" (497 mm)	20.28" (515 mm)	21.06" (535 mm)	
	Electric Wheelchair Users		12.91" (328 mm)	19.57" (497 mm)	14.57" (370 mm)	18.90" (480 mm)	
	Reach Along a Frontal Wall						
	Vertical						
	Able-Bodied		42.91" (1090 mm)	44.88" (1140 mm)	63.19" (1605 mm)	66.14" (1680 mm)	
	Ambulatory Disabled		35.43" (900 mm)	39.76" (1010 mm)	55.71" (1415 mm)	62.20" (1580 mm)	
	Manual & Electric Wheelchair Users		31.69" (805 mm)	31.69" (805 mm)	31.69" (805 mm)	31.69" (805 mm)	No significant reach

Table 13
Wheelchair and User Dimensions

Bails 1988

UFAS Reference	UFAS	Ages 3 - 6.5	Ages 6.5-10.5	Ages 10.5 - 14.5	Ages 14.5 - 18	Comments
A4.2.1 Overall Length	48"	37.01" (940 mm)	38.58" (980 mm)	40.55" (1030 mm)	42.32" (1075 mm)	49.21" (1250 mm) - adult
A4.2.1 Overall Width	26"	22.05" (560 mm)	22.44" (570 mm)	24.80" (630 mm)	25.00" (635 mm)	25.98" (660 mm) - adult
A4.2.1 Foot Plate Width	18"	14.17" (360 mm)	18.11" (460 mm)	19.29" (490 mm)	17.32" (440 mm)	15.75" (400 mm) - adult
A4.2.4 Seat Height	19"	18.50" (470 mm)	20.08" (510 mm)	23.23" (590 mm)	23.43" (595 mm)	18.50" (470 mm) - adult
A4.2.4 Arm Rest Height	30"	24.41" (620 mm)	26.77" (680 mm)	31.50" (800 mm)	29.53" (750 mm)	31.50" (800 mm) - adult
A4.2.4 Knee Height	27"	22.64" (575 mm)	25.20" (640 mm)	25.98" (660 mm)	25.59" (650 mm)	25.98" (660 mm) - adult
A4.2.4 Toe Height	8"	12.99" (330 mm)	14.96" (380 mm)	15.35" (390 mm)	13.39" (340 mm)	11.02" (280 mm) - adult
A4.2.4 Eye Height	43 - 51"	36.42" (925 mm)	36.42" (925 mm)	38.98" (990 mm)	42.13" (1070 mm)	44.88" (1140 mm) - adult

Products and Technologies

With new technology and assistive devices playing an important part in increasing the independence of children with disabilities, the ATBCB requested that the new design standards for children be compatible with or take advantage of any new technology.

As an initial step, the research team reviewed information on different types of assistive devices that were available. The goal was to identify any new products and technologies that might be significant to the development of accessibility standards for children. Thus the work focused on identifying new products and not on documenting the large numbers of products that are available for children with disabilities. Products and technologies were limited to marketed items and did not include prototypes or experimental technologies because these items may never reach the market. Products customized to each user, such as seating systems, environmental controls or personal hygiene items were not selected due to limited use and varied configurations.

Items were selected for review based on their potential impact on the usability of a building or environment. Products were selected because their use may change the way people use the environment (by improving accessibility or minimizing existing problems) and because use of the product may not be ideal under the UFAS. Items considered included mobility aids, communication aids, visual information systems, and storage and seating systems.

Wheelchairs and seating devices were considered that have adjustable height seats, wheelchairs that permit the user to stand or to be lowered to floor level, electronic tablets that use synthesized speech to aid a child with no speech, visual alert and warning devices, telecommunications devices for the deaf (TDD's) and environmental controls.

The review was conducted to determine if any of the devices had characteristics that should be addressed in the revised design standards. In particular, the research team was interested in three key issues:

1. Was the application to children different to the application to adults;
2. Did the device have particular requirements that should be addressed in the design standards; and
3. Was the device widely available to children with disabilities.

The first issue was considered because the revised standards are supplementary to the UFAS and the ADAAG and only cover specifications for children that differ from the specifications for adults. The second issue was intended to identify additional specifications that were not already in the UFAS and ADAAG. The third issue was important because the design standards are applied nationally and cannot specify conditions that are unusual or not commonly available.

Products and technologies were identified through four sources. A search of products listed in Hyper AbleData, a review of products in the Center for Accessible Housing's library, through interviews with selected staff at some of the POE sites (Chapter 4) and through discussions with exhibitors and presenters at the 1990 RESNA conference in Washington, DC. Some follow-up discussions were held with outside experts to better understand the value and application of the technologies. Major findings were as follows.

Improvement of Independence. New products and technologies significantly improve or offer the potential to improve the level of independence and quality of life for children with disabilities. Wheelchairs are available that can lower a child from a standard seat height to a few inches above the floor so the child can get onto the floor to play. The some wheelchairs can support a child in a standing position. Electrically powered wheelchairs are available that permit a child to cover large amounts of irregular terrain easily. Augmentative communication devices such as touch tablets permit children with severe speech disabilities to communicate through synthesized speech. Visual alarms and talking signs provide access to emergency information and other information for children with hearing or visual disabilities. Children who have access to the new technology appear to benefit from use of the devices and improve their independence.

Child/Adult differences in use. When the use of the products was compared to the use by adults, it was difficult to find unusual or significant differences that should be addressed in the revised standards. Children use the products in similar ways to adults with only few exceptions. One is the ability to maneuver a wheelchair in a precise fashion and this is addressed in the revised standard. Another covers the way children use a product such as a wheelchair for play and the need for the seat to lower to the floor so they can get out of or into the wheelchair. However, the lowering to the floor is only possible in wheelchairs that can change seat height and these products are expensive and not widely in use.

Availability. The lack of widespread availability of some of the new products was a concern to the research team. Design standards have not typically specified conditions that cannot be addressed by commonly available products. Many of the new products are not widely available at this time.

For example, the new type of wheelchairs that permit the user to stand or to be lowered to the floor offer important benefits to children with mobility disabilities. A child using one of these devices can theoretically stand to reach an item in a high cabinet, adjust the seat height to use a toilet and lower the seat to make it possible to get onto the floor. If this type of wheelchair was widely available and affordable, then it might be possible to not have children's design standards that have reach ranges that are less then the reach range for adults.

It might also be possible to use standard toilets and sinks in environments for very young children (less than five years old). However, the information from the POEs indicated that new types of wheelchairs is not commonly used and that the wheelchairs and strollers that are used vary from adult size to smaller sizes. Children (particularly children under six years old) who did not propel themselves independently did not spend substantial time using the wheelchair or stroller. Many of these children used their wheelchairs only to move from area to area (with assistance) and spent the rest of the time on the floor crawling or exercising.

Lack of research. It was also difficult to find research or field data on the use of the new products and technologies. None of the research studies that were reviewed covered use of these devices in laboratory settings and the POE data only served to identify a variety of devices that were in use at the POE sites.

The standards that have been developed by this project continue the practice used by the UFAS and the ADAAG of not including specifications for uncommon or extremely expensive products or devices. Wide ranges are provided for seat height (of toilets in particular) because a limited range did not accommodate children of different ages and abilities. Specifications were not included for other new types of products such as speech devices because the use of these devices was not unique from the use by adults. Furthermore, much of the new technology is not permanently installed in buildings and traditionally, the UFAS and the ADAAG have covered elements and features that are permanently installed.

Recommendations

Based on the above findings, the following recommendations were proposed.

The development of new products and technologies for children with disabilities (and for adults as well) is likely to expand significantly due to the the Americans with Disabilities Act and the growing acceptance of new technology by the consumer. The ATBCB should periodically review the design standards for children and make additions and changes as needed. It is likely that the cost for the new products will decrease and this and other factors may make items such as the "standing" wheelchair more widely available.

Although this type of technology is significant, the design standards should continue to reflect the abilities of children who are using common, easily available products and devices.

The ATBCB should also facilitate a study or studies in conjunction with research sponsored by other government agencies such as the National Institute on Disability and Rehabilitation Research (NIDRR) on the use of selected new technology such as power wheelchairs for children. Data from such studies would be useful during future revisions of the design standards.

REFERENCES

Architectural and Transportation Barriers Compliance Board. (1986). *Recommendations for Accessibility to Serve Physically Handicapped Children in Elementary Schools* (March).

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CHAPTER 3

Review of recent evaluation literature on environments for children with disabilities

PREFACE

This chapter reports on an exhaustive review of a range of literature including design guidelines and design research particularly in the areas of post occupancy evaluations of environments designed for disabled children. In an effort to produce information that is both relevant and reflective of the specifications in the current accessibility codes, the literature review focused on sources from 1975 to the present. References prior to 1975 have only been included in the final review when they were considered to be major works in the area of accessibility.

A number of indices and and bibliographic databases were used to conduct the literature review. These included: Avery Index of Architectural Periodicals, Royal Institute of British Architects Index, Resources in Education from the Educational Resources information Center, Psychological Abstracts, Educational Index, Dissertation Abstracts, and Rehabilitation Abstracts.

Topic areas covered included: architecture and handicapped, accessibility, accessible design, barrier free design, architectural barriers, kindergartens, nursery schools, schools, schools and handicapped, museums, libraries, playgrounds, housing for disabled, blind children, brain damaged children, cerebral palsy children, deaf blind children, emotionally disturbed children, learning disabled children, mentally handicapped, mentally ill, mainstreaming, special education, visually handicapped children, classroom environment, and home environment.

The literature review produced one hundred seventy-six references that are directly relevant to the design of environments for disabled children. Although only a few of these are actually post occupancy evaluation or ergonomic studies, all of the references that are included in the final review contain design-relevant information that can be useful in informing the development of standards for accessible environments for children. These references include design guidelines, design research and case studies examples of environments designed for disabled children.

Twenty-three of these references were felt to be particularly important and are included in the annotated bibliography (see Resources). Only two sources were identified that contain relevant ergonomic data. These two resources are compared to the pertinent sections of UFAS in Chapter 2.

Only six of these references contained actual design specifications. A comparative analysis of these specifications and UFAS is presented in the comparative tables beginning on the next page.

Comparative Tables for Design Specifications

Table 1
Accessible Route (Walks and Corridors)

UFAS Reference		UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Nellist	Maryland DOEd.	Comments
4.3.3 Width		36" - 48"		36" min				48" min	
4.3.4 Passing Space		60" every 200' max	60" every 200' max	54" every 200' max				66" min	
4.2.1 Wheelchair Passage		36" min	60"		60"			65"	
4.2.3 Wheelchair Turning Space		60" diameter 60" T turn		60"X60" 36" L turn 42" X 48" around obstruction					
4.2.4.1 Clear Floor Space		30" X 48"							
Alcoves		30" X 48" 36" X 48"	60"X60"						
4.2.5 Forward Reach	AFF AFF	48" max 15" min							
4.2.6 Side Reach	AFF AFF	54" max 9" min							
4.3.8 Changes in Level		max 1/2"	max 1/2"					max 1/2"	
Vertical		≤1/4"							
1:2 Bevel		1/4" - 1/2"							
4.5.1 Surfaces				non-slip, smooth, firm					
Carpet		1/2" pile max		1/4" pile					
Slope of edge strip				≤1:2					
4.5.4 Gratings		1/2" wide max	1/2" max					3/4" max	
4.4.2 Overhead Clearence	AFF	80"	8'-6"						
Frequency of Rest Areas			1/4 mi.						
Joints-depth			1/4"						
Joints-width			1/2"						

Table 1 (cont.)
Accessible Route (Walks and Corridors)

UFAS Reference	UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Holliet	Maryland DOEd.	Comments
4.26 Handrails in Corridors (if used)								
Height								
Single Handrail			26 - 28"					
Double Handrail			26 & 30"					
Perimeter			3 - 6 1/4"					
Thickness			1 - 1 3/4"					
Thickness (one direc.)			1/2" min					
Wall to Rail			1 1/4" min					

Table 2
Ramps

UFAS Reference	UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Nellist	Maryland DOed.	Comments
4.8.1 Minimum Slope	1:20		1:20		1:20			
4.8.3 Minimum Clear Width	36"			48"min				
4.8.2 Maximum Slope	1:12	8.3% for 30'		1:12	1:12			
Maximum Rise	30"/run				30"			
Maximum Run								
4.8.6 Cross Slope	≤ 1:50	<2%						
4.8.4 Landing Length	60" min	60"min	60"min					
Top		60"min						
Bottom		72"min						
4.8.4 Landing Width	ramp width	ramp width	36"min					
4.8.7 Edge Protection (Drop Off)	2" min	2" min	2"					
4.8.5 Handrails (when required)	rise > 6" run > 72"							
4.8.5 Railing Height	30" - 34" AFF				16-24"			
4.8.5 Railing Extension	12"							
4.8.5 Wall to Railing	1 1/2"							
4.21.2 Diameter of Railing	1 1/4" - 1 1/2"							
Railing Load								
Handrail projection past ramp at top/bottom		12" min						
Landing intervals		200'max						
Ramps to thresholds		1:8 if ≤ 3'						
Expansion joints		<1/2"						

Table 3
Handrails

UFAS	Reference	UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Nellist	Maryland DOEd.	Comments
4.21.2	Diameter	1 1/4" - 1 1/2"	see Tables: 1 (Accessible Route), 2 (Ramps) and 4 (Stairs)						
4.8.5	Wall to Railing	1 1/2"							
4.8.5	Height AFF								
	Corridors								
	Height								
	Single Handrail			26-28"					
	Double Handrail			26 & 30"					
	Thickness			1 - 1 3/4"					
	Perimeter			3 - 6 1/4"					
	Min Thickness			1/2"					
	Wall to Railing			1 1/4"					

Table 4
Stairs

UFAS Reference	UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Nellist	Maryland DOEd.	Comments
4.9.2 Treads	≥ 11"	11"	11"	14"	11" min			
4.9.3 Nosings	1/2" r. max	≥ 60 deg	1/2" rad		<1/2" rad.			
4.9.3 Projections	1 1/2" max	1 1/2" max	1 1/2"					
Relative Riser Height		4 - 7 "		5 3/4"				
4.9.4 Handrails Height	30-34"@ nose		both sides 26" - 28"					
Width Between								
Shape		round						
Diameter			1 1/4 -1 3/4"					
Gripping Perimeter			3" - 6 1/4"					
Thickness			> 1/2"					
Wall to Rail			1 1/4"					
Inclined rail past bottom tread		tread width			tread width			
Horizontal rail past top/bottom tread		12" min			12" min			
4.9.5 Warning Strips								
Illumination								
Landing Length								
Top and Bottom Landing								
Steps								

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Table 5
Elevators

UFAS Reference	UFAS	R.Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Maryland DOEd.	Comments
4.10.2 Cab to Floor Landing	1/2" max						
4.10.3 Call Buttons AFF	42" CL				42" CL		
4.10.3 Call Button Minimum Size	3/4"				3/4"		
4.10.4 Hall Lanterns AFF	72" CL 2 1/2" smallest direction						
4.10.5 Hoistway Entrance Markings AFF	60" CL						
4.10.6 Door Reopening Device AFF	5" and 29"						
4.10.6 Doors Open After Reopening	20 sec min						
4.10.8 Door Delay	min 3 secs				3 - 4 sec.		
4.10.9 Car Platform Sill to Edge of Hoistway	max 1 1/4"						
4.10.9 Minimum Cab Size - Side Door	51" X 68"						
4.10.9 Minimum Cab Size - Centered Door	51" X 80"						
4.10.9 Minimum Door Width	36" min						
4.10.12 Car Control Buttons AFF	54" max				54" max		
4.10.12 Emergency Buttons AFF	min 35"						
4.10.14 Emergency Communications AFF	48" max				36" max		
4.10.14 Phone Cord Length	29" min						

Table 6
Doors and Doorways

UFAS	Reference	UFAS	R.Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Nellist	Maryland DOEd.	Comments
4.13.5	Minimum Door Width	32"	32"	32"	36"	32"	33"		
4.13.5	Minimum Width - Openings > 24" Dee	36"				32"			
	Width - Non-Passage Doors	20" min							
4.13.6	Maneuvering Clearance	Fig. 25	48"						
4.13.7	Space Between Series Doors	48" and door width if swing into space	48" and door width	48"					
4.13.8	Thresholds								
	Exterior	3/4" max height	1/2"	1/4"	flush		flush		
	Interior	1/2" max height	1/2"	1/4" max	flush		flush	1/2" max	
	Bevel			1:2 max					
4.13.10	Closer Time	3 sec min							
4.13.11	Force on Door								
	Push or Pull - Exterior	reserved		8.5 lbf		8.5 lbf			
	Push or Pull - Interior	5 lbf		5 lbf		5 lbf			
4.13.12	Automatic Doors								
	Open to Back Check	3 sec max		3 sec max		3 sec max			
	Hold open time				8 sec min				
	Force to Stop	15 lbf		15 lbf max		15 lbf max			
	Type Preferred			sliding pref					photocell or motion detec.pref
4.13.9	Door Hardware								
	Type			lever					
	Force required			3 lbf max					
	Height AFF	48" max							
	Width of approach(outward swing)			60"					
	Width of approach (inward swing)			42"					

Table 7
Curb Ramps

UFAS Reference	UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Nellist	Maryland DOEd.	Comments
4.7.1 When Used	at curb							
4.7.7 Warning Strips								
4.7.3 Minimum Width	36"		36"					
4.7.2 Transitions	flush							
4.7.2 Maximum Slope - Adjacent Surfaces	1:20	1:20	1:20					
4.7.5 Flared Sides	max 1:10	1:10						
4.7.7 Visual and Tactile Warnings	reserved	yes for danger	yes					
4.7.10 Clear Space in Front	48" min	48" min						
4.7.10 Edges		rolled 30 - 45%						
4.7.5 Sides of ramp if portion of walkway			1:10 max					

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Table 8
Protruding Objects

UFAS	Reference	UFAS	R. Moore et al.	People's Housing	G. Moore et al	NYS Schools	Nellist	Maryland DOEd.	Comments
4.4.1	Objects 27" - 80" AFF Objects < 27" AFF Objects in Posts 27" - 80" AFF	4" max no limit 12" max	4"max	4"max" 4"max					"18 - 27"
4.4.2	Head Room	80" min	102"	80" min "					"protect areas under stairs
	Tactile Floor Treatment		yes at danger	top ramps or steps					

Table 9
Signage and Detectable Warnings

UFAS	Reference	UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Nellist	Maryland DOEd.	Comments
	Signage								
4.30.2	Character Proportion								
	Width to Height Ratio	3:5 - 1:1	3:5 - 1:1	3:5 - 1:1					
	Stroke Width to Height	1:5 - 1:8	1:5 - 1:10	1:5 - 1:10					
4.30.4	Type of Characters	Raised or incised							
4.30.4	Raised/Incised Depth	1/32" min	1/32" min	1/32" min	1/32" min				
	Size - Height	5/8" - 2"	5/8" - 2"	5/8" - 2"	5/8" - 2"				
4.30.6	Sign								
	Mounting Height	54" - 66"	42" max		40" max				
	Size					8" min			
	Detectable Warnings								
	Distance from Hazard			12"					
	Depth of Warning		36"	36"					
	Width of Warning			width of path					
	Texture height		1/16-1/8"						
	Resiliency change		yes						
	Visual contrast		yes						
	Groove Sizes								
	Depth			1/8"					
	Width			1/4" every 3/4" 3/4" every 2"					
	Warning Curb			6" min *					*when drop-off > 4"

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Table 10
Parking Spaces

UFAS Reference	UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Neifist	Maryland DOEd.	Comments
4.6.3 Width of Space	96" min				96" min			
4.6.3 Adjacent Access Aisle	60" min				60" min			
4.6.3 Maximum Slope (any direction)	1:50				1:50			
4.6.3 Vertical Clearances	114" min							

Table 11
Drop-Off and Loading Zones

UFAS Reference		UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Helfiet	Maryland DOEd.	Comments
4.6.5	Access Aisle	5' X 20'		12' X 50'					
	Drop-Off to Building								
	Loading Transfer Area			5' X 30'					
	Raised Loading Platform								
	Height			20"					
	Width			54"					
	Level Transfer (road lowered)			20"					

Table 12
Seating/Assembly Areas

UFAS Reference	UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Nellist	Maryland DOEd.		Comments
4.2.4.1 Clear Floor Space for Wheelchairs	30" X 48" min		30 X 60"						
Between Seats									
Aisle Width			36"						
4.32.2 Table to Wall Distance									
4.33.3 Placement of Wheelchair Seating	Dispersed								
4.33.7 Listening Systems	Max 50' from stage								
4.33.5 Stage Access (ramp)			1:20 max						

Table 13
Libraries and Media Centers

UFAS	Reference	UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Nellist	Marylanc DOEd	Comments
8.4	Card Catalogs - Clear Width	36"		*					*28 X 48" cl fl space (side approach)
8.4	Card Catalogs - Reach	AFF 48" preferred AFF 54" max AFF 18" min		36" max*					*drawer height
8.5	Stacks - Clear Width	36" min 42" preferred							
8.5	Stacks - Height	unrestricted		36" max					
	Counters (front approach)								
	Clearance beneath			24" min					
	Width beneath			28" min					
	Depth beneath			17"					
	Width above			30"					
	Counters (side approach)								
	Clear floor space			28"d X 48" w					
	Counter height			30" max					
	Counter width			30" min					
	Width - main aisle			44"					
	Width - side aisle			36"					

Table 14
Classrooms and Instructional Areas

UFAS	Reference	UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Nellist	Maryland DOEd.	Comments
	Wall Mounted Objects AFF			36" max					
	Minimum Blackboard Height AFF			24" max			15"		
	Floor Areas								
	Lighting - Classrooms								
	Lighting - Labs & Multipurpose Rooms								
	Tables & Work Surfaces - Width							36" min	
4.32.4	Tables & Work Surfaces - Height	28" - 34"		30" max	30" max			adjustable	
4.32.3	Arm Rest Clearance AFF	27"							
4.32.3	Knee Space - Depth	19"							
4.32.3	Knee Space - Width	30" min							
	Clearance Under Tables			24" min					
	Seat Height			15-17"					
	Height - Bottom of Window						28"		
	Sink								
	Side Approach (cl fl space)			28 X 48"					
	Front Approach								
	Width of opening under sink			28" min					
	Clear Height under sink			24" min					
	Depth under sink			17" min					

Table 15
Storage

UFAS	Reference		UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Heillet	Maryland DOEd.	Comments
	Storage Closet									
4.25.2	Clear Floor Space		30" X 48"		60" X 60"					*25-30sf per classroom
4.25.3	Height	AFF	54" max							
	Aisle Width				36" min					
4.25.3	Clothing Rods	AFF	54" max							
	Clothing Hooks	AFF			36"			42 - 54"		
	Clothing Hook Spacing							24" CL		
	Shelves	AFF			36"				adjustable	
	Locker Rooms-Lockers									
	Opening size				28"					
	Height of Hooks				36"					
	Shelving				36"*					*If shelf is <12" deep
	Handle				lift, pull or trigger latch					
	Wardrobe Height				54"					

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Table 16
Toilets, Urinals, and Toilet Stalls

UFAS Reference			UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS schools	Neilist	Maryland DOEd.	Comments
4.16.3	**Toilet Height**	AFF	17" - 19"				16 - 17" 33 - 36"	12" Nursery 16" other		
4.16.4	Grab Bar Height	AFF	33" - 36"							
4.16.5	Flush Controls	AFF	44"							
4.16.6	Toilet Paper Dispenser									
	Height	AFF	19" min to CL							
	Distance from Rear Wall									
	Urinals									
4.18.2	Height	AFF	≤17"				14"	24"		
4.18.3	Clear Floor Space		30" X 48"							
4.18.4	Controls	AFF	44" max				32"			
	Toilet Stalls									
4.17.3	Width		36",48",60"				48" min	54"		
4.17.3	Length		56",59",95" min				66" min	63"		
4.17.4	Toe Clearance	Depth AFF	9" min							
4.17.3	Clear Space Outside		42" - 48"							
	Door Height						58.5" Nursery 66" Jr High 78" Sr. High			
4.17.5	Door Width		32" clear							
	Grab Bars									
4.17.6	Height	AFF	33" - 36" CL				32"			
	Length on side wall						42"			

Table 17
Lavatories, Bathtubs, and Showers

UFAS Reference			UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Heillst	Maryland DOEd	Comments
	Lavatories & Sinks									
4.19.2	Height	AFF	34" max				34" max	27 - 33"		
4.19.2	Vertical Clearance	AFF	29" min				27"			
4.24.3	Knee Space Height	AFF	27" min		24" min		30"			
4.24.3	Knee Space Width		30" min		28" min					
4.24.3	Knee Space Depth		19" min		17" min		19"			
4.19.2	Toe Space									
4.24.4	Bowl Depth		6 1/2" max							
4.19.6	Mirrors - Bottom Ht	AFF	40"							
	Grab Bars									
	Bathtubs									
4.20.2	Clear Floor Space		30 - 48" w 60 - 75" l							
4.20.4	Grab Bars - Top	AFF	33" - 36" CL							
4.20.4	Grab Bars - Bottom		9" ab rim							
	Showers									
4.21.2	Shower Stalls		36" X 36"		36" X 36"					
4.21.2	Roll-In Showers		30 X 60" min		30X60" min					
4.21.3	Seat Height	AFF	17" - 19"		15 - 17"					
4.21.5	Controls Height	AFF	48" max		28 - 36"					
4.21.6	Hose Length		60" min		60"					
4.21.7	Curbs	AFF	1/2" max		1/2"					
4.21.6	Fixed Shower Height	AFF								
4.21.5	Hose Connection	AFF								
4.21.4	Grab Bar Height		33-36"		23 - 26"					
	Seat Width				36"					
	Seat Depth				16"					
	Clr Floor Sp. outside				28 x 48"					

Table 18
Drinking Fountains & Water Coolers

UFAS	Reference	UFAS	R.Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Nellist	Maryland DOEd.	Comments
4.15.2	Spout Height AFF	36" max		30"					
4.15.3	Spout Location	front			front				
	Water Flow	min 4" vertical				min 4" vert			
	Controls								
4.15.4	Location	front or side							
	Type			lever or push bar	foot/hand				
	Knee Space								
4.15.5	Vertical AFF	27" min		24" min					
4.15.5	Depth	8" min		17" min					
4.15.5	Width	30" min		32" min					
4.15.5	Toe Space	6"d X 9" m high							
	Clear floor space (front)			30" X 48"					

Table 19
Controls & Operating Mechanisms

UFAS Reference	UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Nellist	Maryland DOEd.	Comments
4.27.2 Clear Floor Space	30" X 48"							
Height								
4.27.3 Controls/Switches AFF	48" - 54"						48" max*	*applicable to switches
Outlets AFF	9 - 15" min							

Table 20
Alarms and Life Safety

UFAS Reference	UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Neifist	Maryland DOEd.	Comments
Audible Alarms								
4.28.2 Sound Level	15 db over ambient or 5 db over max sound for 30 secs							
4.28.2 Maximum Sound Level	120 db							
Visual Alarms								
4.28.3 Flashing Frequency	< 5 Hz							
Refuge Area			48" X 72"					

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Table 21
Public Telephones

UFAS	Reference	UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Nellist	Maryland DOEd.	Comments
4.31.2	Clear Floor Space	30" X 48" min				30" X 48"			
	Parallel Approach			28" X 48"					
	Front Approach			28 X 48 X 24"h					
4.31.3	Mounting Height AFF	top ≤ 48" - 54"		36" max*		54"			*Highest operable part
4.31.8	Cord Length	29" min							
	Enclosure Edge to phone			17" max					

Table 22
Restaurants & Cafeterias

UFAS	Reference	UFAS	R. Moore et al.	People's Housing	G. Moore et al.	NYS Schools	Nellist	Maryland DOEd.	Comments
	Food Service Lines								
5.2	Clear Width AFF	36" min		36" min					
	AFF	42" preferred							
5.2	Tray Slides AFF	34" max		30"					
5.2	Self Service Height AFF	54" max		30" max					
	AFF	9" min							
	Forward/Side Reach			12" max					
	Knee Space Under Tray Slide								
	Seating Area								
	Seat Height			15-17"					
	Table Height			30" max					
	Clearance under Table			24"					
	Space between Tables or Wall			48"					

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CHAPTER 4

Post-occupancy evaluations of accessibility of environments serving children with disabilities.

PREFACE

This chapter reports on post-occupancy evaluations (POEs) that were conducted at nine sites frequented by children with disabilities. The primary purpose of the POEs was to observe and evaluate the suitability of accessible features, built to different technical specifications, for children of different ages whose disabilities differed in type and severity. In addition, information was obtained about how well existing features worked for adults, such as teachers and house parents, whose jobs involved interaction with children at each site.

The information obtained through POEs provides direct evidence of how well and in what ways as-built design features, which are addressed by UFAS and the ATBCB Recommendations, work (or do not work) in the context of a real building for one or more children with disabilities. Thus, while Task One produced information on the scope of building features required by state codes and other regulatory instruments to be accessible and the technical specifications to achieve accessibility, and Task Two reviewed existing research from a variety of disciplines that is relevant to establishing accessibility requirements for children's environments, Task Three focused on obtaining and synthesizing detailed, original information on the suitability of existing accessible features for children.

This report consists of an extended Summary and the individual Site Reports. The Summary contains a detailed description of the methodology used, including site selection process and instrument development, site descriptions, and an overview of the findings and conclusions from the individual POEs. Each of the sites at which POEs were conducted are unique in one or more important ways from the others sites. Consequently, many important details do not lend themselves to summarization and synthesis. The Site Reports, found in Appendix A, provide in-depth information on the physical measures and evaluative data vis a vis existing accessible features for each site. The Site Reports contain extensive illustrations. Appendix B contains copies of the data collection instruments and consent forms used in this project.

The findings section in the Summary and the Site Reports are organized around the topical issues for which UFAS, the ATBCB Recommendations, and other regulatory documents have established technical requirements relevant to achieving accessible children's environments. The consistent use of these issues as an organizational device in the Tasks One, Two and Three reports is intended to facilitate comparison across the different data sources that distinguished these Tasks.

SUMMARY

METHODOLOGY

This section contains a description of the site selection process, informed consent procedures, and the data collection protocol as well as instruments developed for the study. The protocol, with limited variations necessitated by site-specific requirements, was implemented at all of the sites. Copies of the consent forms and data collection instruments used in this project are included in Appendix B of this report.

Site Selection

Several criteria were used to guide selection of the eight POE sites. These are:

- Sites must be built or renovated to accessibility codes/standards or acknowledged by experts (e.g., Advisory Committee) as state-of-the-art accessible children's environments.
- The sites, collectively, must serve children of diverse ages (e.g., preschoolers to teens) who experience different types of disabilities (e.g., mobility, sight and hearing impairments).
- Sites must represent a variety of building types that could potentially be built with Federal funding and therefore would need to comply with MGRAD/UFAS; for example, educational facilities, day care centers, libraries or other community/recreational sites, and residential settings (e.g., congregate or multifamily housing).
- To insure that an adequate number of data points are obtained to evaluate the effectiveness of accessible features, preference will be given to sites with larger numbers of disabled children who routinely use the site.
- To minimize the travel costs associated with the POEs, six of the sites will be located in geographic locales that capitalize on the home bases of the research team members. Two sites will be selected from those available in the Raleigh, NC area, two from the metropolitan Atlanta area, and two from the metropolitan Boston area. The remaining two sites will be selected through consultation with the Advisory Committee and others knowledgeable about exemplary programs and facilities nationwide.

The site selection process occurred in several phases. Initially, the research team met and brainstormed types of facilities to be included in a list of potential sites. To help focus this process, "children" were defined as those no more than 14 years old and/or in the ninth grade. This information was summarized in a matrix that cross-referenced type of facility by location of the site/research team to conduct the POE (i.e., Raleigh, Atlanta, Boston, at-large). Examples of potential sites were entered in the cells of the matrix. This matrix and a cover letter requesting input was sent to the Advisory Committee by the Principal Investigator. Follow-up with the Advisory Committee yielded several good suggestions as to sites.

The second phase of the site selection process was characterized by extensive networking to identify contact people at the potential sites who could give approval for participation in the project. Contacts and approval went quickly and smoothly in some cases -- typically those facilities where the research team had entre to a high level administrator, and/or those facilities that had a vested interest in accessibility (e.g., primarily served disabled children). Public school systems with "integrated" facilities (i.e., disabled and nondisabled children used the same building and were served by the same programs) were the most difficult to reach and involve in the study. These difficulties were primarily related to the bureaucratic nature of the larger systems (e.g., facilities and access to students and staff were controlled by different Assistant Superintendents, lengthy review procedures to obtain permission to conduct research in a school system).

A concerted effort was made to include a school built or renovated to the ATBCB's *Recommendations for Children's Environments*. An Advisory Committee member identified one such site in rural Nebraska, but the time and travel costs involved in conducting a POE at this site made it unfeasible. Staff of the ATBCB and U.S. Department of Education were unable to identify a less remote site built to these Recommendations.

The sites included in the study were:

BCM: Boston Children's Museum, Boston, MA
GHPS: Preschool Handicapped Classroom Facility, Gainesville, FL
GAB: Georgia Academy for the Blind, Macon, GA
MHS: Massachusetts Hospital School, Canton, MA
MHPS: Baylies Beginning Center, Massachusetts Hospital School, Canton, MA
RES: E. Rivers Elementary School, Atlanta, GA
UCP: United Cerebral Palsy Developmental Center, Spring Lake, NC
WCS: East Wake Middle and Vance Elementary Schools, Raleigh, NC
WPSCB: West Pennsylvania School for Blind Children, Pittsburgh, PA

Informed Consent

The NCSU Human Subjects Committee reviewed the project and approved an Information About Sheet, and consent and video release forms that were developed for the project. The Information About form provided a short, easy-to-understand summary of the project. It was directed at administrators, parents and others who might benefit from such a summary. The consent and video release forms were to be signed by parents/ guardians in advance of data collection to authorize their child to participate in the study and be video-taped/photographed while participating. When a facility agreed to participate, a facility administrator assigned to work with the research team received a pre-site visit package that included multiple copies of these materials for distribution to parents/guardians. Signed consent/release forms were picked up when the research team visited the site to conduct the POE.

Data Collection

Three broad types of information were obtained through the POEs: background information on each site and its users; description of accessible features; and evaluation of accessible features data.

Background Information: The intent of this portion of the data collection was to obtain basic descriptive information about the children who use a facility and the facility, and to request this information in a way that was easy for administrators to complete. This information needed to be obtained in a manner that was useful in describing a specific site, and could be compiled to describe the sites as a group.

A Background Information data collection form was developed to obtain general demographic descriptions of the disabled children who regularly used a site (e.g., number of disabled children who use the site regularly, percentage of total children who are disabled, numbers of children by age and disability, assistive devices used by current facility population, etc). In addition, this form asked for the age of the building(s) to be studied, and date and description of renovations. This form was typically mailed out with the consent forms and picked up when the site visit was made.

Frequencies for data about students and assistive devices were prepared for each site and the sites as a whole.

Description of Accessible Features: The intent of this portion of the data collection was to document the physical characteristics of the design features at a given site that impact access. The overall approach and procedure to insure that comprehensive documentation was accomplished was based on several precedents including: (1) the Historic American Buildings Survey/Historic

American Engineering Record (HABS/HAER) protocols[1], which are widely acknowledged as the gold standard in documenting physical characteristics of buildings and their design features; and (2) a protocol that has been developed for use in several Center for Accessbile Housing projects to evaluate accessible housing and adapted for use in describing the home environments of elderly subjects in an National Institute on Aging sponsored study which is being conducted by staff of the School of Rehab Medicine, Emory University.

Scope: Descriptive data on accessible features were obtained through a systematic process of measurement and photography of "as built" design features. The specific technical requirements for which physical measures data were obtained were derived from the listing used in the Task One analysis. This list was reviewed and modified for use in Task 3 in accordance with the following considerations. Technical requirements not judged to be age-related (i.e., there was no reason to expect children to differ from adults in terms of accessibility needs, such as the sound level of an audible alarm) were not addressed in Task 3. Technical requirements for which there were different specifications across major regulatory documents (i.e., UFAS, the ATBCB Recommendations) were addressed. Technical requirements for which there is consensus in specifications, but which are thought to not work well for persons with disabilities, despite that consensus, were addressed[2]. In planning the site visits, as a whole, an effort was made to insure that two or more data points would be obtained for each technical requirement of interest.

The field instruments and data tables derived from the Task One work preserve the Task One table numbering, even though the above process resulted in the elimination of some of these tables for the purposes of Task 3. This was done to facilitate comparison of the data obtained through this task with that obtained through Tasks 1 and 2.

Instrument Development: A Physical Measures instrument was developed to record physical measures data on the list of technical requirement identified in the above manner. UFAS section numbers, where applicable, were added to short descriptive titles. Whenever possible, the same short titles were used in this instrument as those used in the Task One Tables. In some cases, the list of technical requirements were reordered from that used in Task One to facilitate data collection. Written measurement instructions and, where possible, illustrations were used to insure consistency in the measurement of accessible features across sites by different researchers. The space on the forms allocated for dimensional data on a specific requirement was cross-referenced to the drawings, where applicable. The written instructions were largely derived by rewording the instructions in the access audit portions of the *UFAS Accessibility Checklist*, an ATBCB sponsored project. Illustrations were taken from UFAS. A blank Physical Measures form was used to obtain data on innovations and accessible features important at a site but not included in the structured portion of the form.

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[1] Although these surveys differ in focus and scope, they provide insights about the documentation process and data collection. For example, whereas the focus of HABS/HAER is historic documentation, the four-step process of identification, description, photographic and graphic illustration is applicable to any architectural inventory. In addition, the recording methods and techniques are fundamental tools for examining any structure. The NPS Building Inventory and Inspection Survey, like HABS/HAER, is designed to document physical properties (in this case condition) of structures. Using a three-level hierarchy of scales, this survey describes structures in terms of the National Park, the building itself, and each of the systems (e.g. roof, electric, plumbing, structure, etc.) in the building.

[2] These considerations, in addition to the accessible features found at the sites, resulted in the elimination of items covered in Tables 8 (Protruding Objects), 10 (Parking Spaces), and 20 (Alarms) from the Task One tables from the scope of issues addressed by Task Three. Additionally, items in Task One Tables 3 (Handrails at Ramps) and 19 (Controls) were integrated into other tables. Table 3 items are included on Table 2 (Ramps). Table 19 items are included in a number of tables; for example, Task 3's Table 16 (Toilets, Urinals, and Toilet Stalls) contains physical measures for flush controls for toilets and urinals.

The physical measures data collection was scheduled as early as possible in the site visit. This scheduling permitted the research team to grasp the scope of accessible features present at a given site as well as to obtain a general understanding of the technical requirements underlying those features prior to conducting the observational or small group data collection.

Data Analysis: The physical measures data were summarized in two ways. First, all physical measures and the frequency of each measure (e.g., 3 toilets at *x* height) were summarized on the physical measures field instrument. Data for all buildings and building types were combined in this summary. These data are included in the Site Reports (Appendix A).

Second, the site data were further collapsed to the single value or range of values observed at a given site for each technical requirement. These data were compiled in a series of matrix tables, derived from those used in Tasks 1 and 2, that summarize physical measures data for the various technical requirements by site. These tables are included in the Findings section of this Summary.

Photographs and drawings are used in the Site Reports, and in the Findings section of this report to illustrate the as-built features found at each site.

Evaluation of Accessible Features: The intent of this portion of the data collection was to obtain multidimensional information on the suitability of as built features that, according to code, should be accessible. The site selection process permitted examination of the question of "suitability" for children of different ages, and with different types of disabilities of different severity. Multidimensional approaches to evaluation are often viewed as advantageous because data are obtained from multiple perspectives (e.g., self-report of children and/or staff re: suitability of accessible features, observation by experts of suitability) that may or may not agree in their assessments. Additionally, a multidimensional approach also provides a data "safety net" in field research where it is not always possible to complete the full protocol.

The protocol developed for this project obtained observational and self-report data on the suitability of frequently, infrequently and sensitive use accessible features for disabled children as well as others who use each facility. Data were obtained from facility administrators, staff, children, and others with a vested interest in the accessibility of a facility.

- **Observational Data:** Naturally occurring usages of frequently used accessible features, and simulated usages of infrequently used and sensitive use accessible features were systematically observed. Naturally-occurring as well as simulated usages were video recorded for subsequent analysis.

  Scope and Procedure: Observation of naturally-occurring usages of accessible features was limited to those features that received a high incidence of use at predictable times. For example, naturalistic use of accessible provisions for drop off and passenger (un)loading zones and entry/exit portions of accessible routes could be observed at the beginning or end of a school day. Features to be observed in this way were identified through consideration of the facility program and in consultation with on-site staff. Video-based observation was accomplished as unobtrusively as possible. The camcorder operator stationed him/herself in as inconspicuous a location as was possible to obtain a good angle of recording. Supplementary lighting was not used.

  Simulated usages provided the observational data for other features for which observational data were desired. In advance of the site visit, the contact person was asked to identify a small number of children to participate in the simulated use of selected accessible features. These children were drawn from those whose parent/guardian had agreed for them to participate, and those administrators judged to be able to follow instructions. In some cases (e.g., cottages for multiply disabled children with severe developmental disabilities at the Georgia Academy), there were no children who met these criteria, and systematic observational data could not be obtained.

  Children who participated in the simulated usage portion of the data collection were given simple instructions -- *Show me how you would go about taking a shower.* Specific prompts to simulate use of various accessible features were not given unless the child had overlooked them. For example, if the child went in the shower stall, reached for the hand shower, and began to simulate rinsing off, he/she would be prompted -- *Show me how you would turn the water on.* During the simulations, some children volunteered explanations (i.e., self-report data) of what they were doing and why. In other cases, they answered questions posed by the research team related to the simulated activities. This self-report data obtained in conjunction with the observational data has proved useful in understanding site-specific suitability of accessible features. This information was captured on the video tape, albeit of varying quality depending on the volume of the child's voice, his/her distance from the camera, etc.

Data Analysis: Both types of observational data were coded in the same manner. The unit of analysis for the coding was the technical requirement(s) embodied in a specific accessible feature. In other words, each observed incidence of use of a given lavatory, for example, was rated in relation to height of rim, knee space width/depth, etc. This level of analysis permits one to account for a situation where the rim height appeared to pose no difficulties, but an observed user in a wheelchair was unable to easily wash his/her hands because of the underbowl clearance for the knees or reaching distance to faucet controls. Ratings were assigned to the pertinent technical requirements for each observed use of a given accessible feature.

A five point scale was used to code the observational data: (1) = Unable to use; (2) = Able to use but with much difficulty; (3) = Able to use with moderate difficulty; (4) = Able to use with little difficulty; and (5) = No problems in use. The ratings are based on the degree of difficulty involved in use. Coders were instructed to consider several ways that "difficulty" might be signified in the observational data; relative physical effort required to use X/do Y, relative length of time required, or apparent risks/threats to physical safety during use.

Ratings for each technical requirement for a given feature were averaged. If observational data of the same accessible feature (e.g., the same lavatory or two lavatories with identical physical measurements) were obtained that involved children of different age groups (see Appendix B. Background Information Form re: the age groupings), coding and subsequent averaging of ratings was done by age group.

These ratings are discussed in the site reports and averages are summarized for all sites in the Findings section of this report.

- **Self-Report Data:** Small group meetings were the primary means of obtaining information from staff as to the suitability of accessible features for children as well as themselves. Small group meetings also were held with children when, in the judgement of the facility administrator, children could be identified that could meaningfully participate (e.g., old enough, verbal enough, etc.) in such a meeting.

Scope and Procedure: Small group meetings were scheduled, if possible, after the research team had had an opportunity to tour and document the facility. This scheduling provided the group facilitator with information about on-site accessible features needed to conduct the meeting.

The group discussions were focused by general and specific questions about the accessible features at a given site -- *How well do the accessible features (does X) work for you in your interactions with the children? For the children? Why, why not? What would you like to see changed?* Initially, general questions were used to encourage participants to bring up the issues important to them, rather than just respond to the research team. General questions were followed by questions about specific accessible features that had not been previously discussed. The actual questions were modified, depending on adult or child group composition. Group discussions were recorded on newsprint and displayed to the group during the discussion.

Data Analysis: The notes from the group discussions were subjected to a content analysis to identify the UFAS technical requirement(s) number(s) to which it referred, if any. The responses were subsequently sorted by technical requirement. These data specific to each site were used to prepare the Site Reports. Additionally, these data were compiled across sites for use in preparing the Findings section of this Summary.

FINDINGS

Background Information

Facilities: Post occupancy evaluations were conducted at nine sites.

The sites are:

- Children's Museum, Boston, MA *(BCM)*
- Preschool Handicapped Classroom Facility, Gainesville, FL *(GHPS)*
- Georgia Academy for the Blind, Macon GA *(GAB)*
- Baylies Beginning Center, Massachusetts Hospital School, Canton, MA *(MHPS)*
- Massachusetts Hospital School, Canton, MA *(MHS)*
- E. Rivers Elementary School, Atlanta, GA *(RES)*
- United Cerebral Palsy Developmental Center, Spring Lake, NC *(UCPDC)*
- East Wake Middle and Vance Elementary Schools, Raleigh, NC *(WCS)*
- West Pennsylvania School for Blind Children, Pittsburgh, PA *(WPSBC)*

These sites include: two preschool sites for young children with disabilities and an integrated preschool; three residential schools for singly and multihandicapped children with vision, and orthopaedic disabilities; two newly opened integrated public schools; a 1950's elementary school renovated to be accessible; and a children's museum. In addition to the educational settings incorporated into all of the sites, some sites presented an opportunity to evaluate accessible features in other types of settings such as residential and recreation/leisure.

On-site facilities varied widely in age. Two sites utilize facilities built in the nineteenth century. One site was occupied less than nine months ago. Most facilities included in the evaluations were built since the 1950's, with many buildings occupied or renovated since 1985. Five sites included one or more buildings that were built to be accessible: Boston Children's Museum; Preschool Handicapped Classroom; UCP Developemental Center; and Wake County Schools (two sites). Renovated sites varied widely in the extensiveness of accessibility retrofits that had been undertaken, and the apparent standard on which they were based. In summary, the sites represented a cross section of children's environments in terms of building types, age, and type and extent of intended accessibility.

Populations of Sites: The children with disabilities who use these sites range in age from infants to young adults. Several schools included in the sample of sites (i.e., the Georgia Academy for the Blind, the Massachusetts Hospital School, and the West Pennsylvania School for Blind Children) have students who are older than our operational definition of the age of children ($\leq$14). These young adults were involved in only a limited way in the on-site data collection. Demographic information on these older students is not included in the following summary description.

Among the children age 14 and younger at the sites studied, 107 were unable to walk and 44 walked with difficulty; 58 had no usable vision and 150 were low vision; 29 were unable to use their arms and/or hands and 78 had limited use of their arms and/or hands; and 9 had severe hearing loss and 9 had mild to moderate hearing loss. (As many of the children were multidisabled, some children were counted more than once in characterizing the types and severity of disabilities among children at the various sites.) In addition, many of the students at the sites experienced developmental, emotional and related disabilities in addition to physical and/or sensory disabilities.

A wide variety of aids and devices were used to assist students in moving through buildings and the exterior environment. These included manual and power wheelchairs, walkers, crutches, canes and long canes. However, it should be noted that substantial numbers of the children at several sites used no aid or device, at least under some circumstances. For example, preteen students at the Georgia Academy for the Blind who were singly impaired were seldom observed to use long canes or other orientation and mobility devices out-of-doors, and no student was observed using a long cane in a building. At the Gainesville Preschool site, only one student used a wheelchair and he only used it on arrival and departure. In contrast, the students at the Massachusetts Hospital School were multiply and severely disabled. They relied heavily on wheelchairs and other devices.

Description and Evaluation of Accessible Features

Accessible Route: The *width* of accessible routes varied extensively within and across the sites. The narrowest width observed was 43" (UCP) and the widest was 138" (BCM). The MHS had the greatest range of widths of accessible routes (45" to 112"). The narrowest of these widths were close to the upper end recommended by UFAS (48"). Other physical measures related to accessible route technical requirements met or were similar those currently required by UFAS (Table 1, Photos 4-8).

Where there were a number of children in wheelchairs using a pathway at the same time, the wider routes helped to avoid congestion and permitted two-way traffic (e.g., MHS). In addition, because children frequently do not have finally honed skills in maneuvering wheelchairs, the wider pathway were compatible with their skill level. Finally, in settings used by children in wheelchairs as well as children with sensory disorders, wider routes helped to prevent accidents (e.g., WPSBC).

Ramps: Three sites had no ramps (GHPS, MHPS, and UCP). Where ramps were present, they varied widely in *slope*. Five ramps were steeper than the maximum slope of 1:12 prescribed by UFAS. The steepest ramp had a slope of 1:4 (WPSBC); two had slopes of 1:9 (BCM and MHS); and two had slopes of 1:10 (GAB and RES) (see Table 2, Photos 9-11). The ramps at the Georgia Academy for the Blind appeared to have been installed as retrofits in existing stairwells and the pathways leading to them. Four sites had ramps with slopes that were less than 1:12. The shallowest ramp was 1:29 (MHS). Other ramps that were shallower than the maximum 1:12 slope permitted by UFAS included 1:13 and 1:19 (WPSBC), 1:16 (WCS), and 1:20 (RES).

Many children, particularly those in manual wheelchairs, experienced difficulties ascending ramps that were steeper than 1:12. At several sites, children were either not able, or not permitted, to use ramps independently because of the physical strength, stamina and skill that was necessary. At some sites (MHS and WPSBC) staff or parents pushed the children. Moreover, staff at MHS maintained that 1:12 was too steep and that 1:16 would be preferable.

The *clear width* of ramps also varied widely. The narrowest ramps were 36.5" (RES), 41.5" (WPSBC),45" (MHS), and 48" (BCM, GAB) wide. All of these ramps exceed the UFAS minimum of 36". The widest ramps were in excess of 116" wide (GAB, MHS, WCS). The wider ramps help to avoid congestion and accidents at sites where a number of children in wheelchairs had to use the ramp at the same time (e.g., MHS, BCM).

Cross slope was only recorded at one site (WPSBC) where it was measured at 1:24 to 1:48. These slopes exceeded the 1:50 maximum permitted by UFAS and created great difficulty for students using the exterior site.

Where landings were present, the *lengths and widths of landings* were close to or met UFAS requirements. Problems were neither observed nor reported regarding the size of landings.

Edge protection was observed at only one site (MHS) where it exceeded the UFAS minimum by 6". At the four other sites with ramps (BCM, GAB, WCS, WPSBC), those ramps had no edge protection. At the BCM several of the children in wheelchairs were observed dropping off the side of the ramp due to the the lack of edge protection.

Handrail height at ramps were typically between 32" and 34" AFF. These heights are at the mid to high range permitted by UFAS (30" to 34"). One rail exceeded UFAS (36" AFF, GAB). All of the observed handrail heights exceeded the Children's Supplement recommendation of 26" to 28" AFF. Both staff and children at MHS reported that removal of most of the handrails due to reconstruction of the walkway system made the hilly terrain very difficult to negotiate.

Railing extensions, where present, exceeded the UFAS requirement of 12". In two cases, railing extensions were 13" (WCS, WPSBC), in one 18" (BCM) and in another 31" (WPSBC). No evaluative data were obtained regarding the suitability of handrail extensions.

Wall to railing distances ranged from 1.5" (GAB, WPSBC), which complies with UFAS, to 9" (BCM). No evaluative data were obtained regarding the suitability of wall to railing distances.

Railing diameters were as large (1.5") or larger (1.75", 2", 6") than the upper end of the UFAS requirement (1.5"). No evaluative data were obtained regarding the suitability of railing diameter.

Stairs: Stairs were observed at only three sites. *Treads* ranged from 11.5" (GAB) to 12" (BCM, WPSBC) in depth. *Risers* ranged from 5.5" (GAB) to 6" and 7" (BCM). *Nosings* on stairs, where present, were 1". No problems were reported or observed with regard to these stair dimensions.

Handrail height varied widely at the Children's Museum (16" to 37" above nosing). Only one of four handrails at this site met the UFAS requirement of 30" to 34" above nosing. No stairs were observed with less than 8 steps, which is well within the minimum per rise specified in the Florida standard.

At GAB, the absence of tactile warnings on stairs was problematic for visually impaired children. WPSCB findings indicate that such warnings should be "wider" than 12 inches and extend 36 to 48 inches back. The two surveys disagree on the effectiveness of high-contrast painted warnings.

Elevators: Elevators were present at five sites (Table 5). *Call buttons heights* ranged from 40.5" AFF (MHS) to 43" AFF (BCM, WPSBC). All of these heights were higher than the Children's Supplement maximum of 34" AFF. *Call button size* ranged from 11/16" (WPSBC) to 1.25" at the other three sites. These sizes are close to or are larger than the UFAS minimum of 3/4". *Car control buttons* ranged from 38.5" AFF (WCS) to 52" AFF (MHS). All of these measures are within UFAS, but all were higher than the maximum of 36" specified in the Children's Supplement.

The height of call and car control buttons were too high at all sites for children to use easily, if at all. At BCM and MHS, the diameter of the call buttons were too small for children with limited hand and finger control.

Doors: The *clear width* of most doors met or exceeded the UFAS minimum requirement of 32", with the majority ranging between 32" and 37" in width (Table 6, Photos 12-14). Two doors were observed whose clear widths were less than 30" (GHPS, 28"; GAB, 29"). The narrow door at the Georgia Academy was an entry door to a bathroom located between two double occupancy residential rooms. Wider doors (36" to 60") also were observed at all of the sites. No problems related to door width were reported or observed.

Exterior thresholds were not present at five sites (BCM, GHPS, MHPS, MHS, WCS). Thresholds that were .25" higher than the UFAS maximum of .75" were observed at the UCP and GAB. In contrast, several sites (GAB and RES) had .5" thresholds that were .25" lower than the maximum allowed by UFAS. The .5" high exterior threshold at RES was difficult for a young child in a wheelchair with limited upper body strength.

Interior thresholds were not present at four sites (GHPS, MHPS, MHS, WCS). At GAB one interior bathroom threshold (1.5") exceeded UFAS requirements by 1.0". All other thresholds were within the UFAS limitations. While no problems related to the height of interior thresholds were reported, no children in wheelchairs were assigned to the cottage in which this threshold was observed.

Door hardware ranged in height from 34" AFF (BCM) to 45" (MHS). The most commonly observed heights were between 37" and 41" AFF. While these heights were below the upper limit set by UFAS (48" AFF maximum), only one site (BCM) had door hardware that was within the limits of the Children's Supplement (36" AFF maximum). At MHPS and MHS, hardware installed at the UFAS requirements was difficult to reach for children of different ages who used wheelchairs. At UCP door hardware was installed somewhat lower (39"-41" AFF) than the UFAS maximum, but exceeded the 36" maximum allowed by the Children's Supplement. Staff reported worked well for children as well as adults.

One door was observed that used an electronic/mechanical closer. The main entry door at the Gainesville Preschool was a sliding door that was activated by a motion sensor. The sensor could be manually overridden by teachers if desired. The door stayed open as long as motion was detected. A power sliding door was also used at WPSBC. These types of doors, in contrast to hinged doors with automatic closers were observed to easily accommodate the age- and disability-related differences in speed at which children could move through doorways.

Exterior and interior forces to operate doors varied widely. The exterior doors requiring the least force to open were at MHPS (2 lbf). More common force measures for exterior doors were between 8 lbf (MHS) and 16 lbf (GAB). The interior doors requiring the least force to open were found at MHPS (1 lbf), MHS and GAB (3 lbf). The interior doors requiring the most force to open were at UCP (11.8 lbf), GAB (12.75 lbf) and RES (16.5 lbf). Opening doors was one of the most pervasive problems reported across sites, age groups and disability groups. Virtually all children, not just those in wheelchairs or with gait and balance disorders experienced difficulty in pushing/pulling doors open. This was true for all doors, although the amount of difficulty encountered appeared to be a function of the amount of force required and the strength of the child.

Curb Ramps: *Curb ramps* were not necessary at six sites due to the installation of ramps from the vehicular drop-off area (BCM, MHPS, MHS, RES) and/or the use of blended levels (GHPS and UCP) which eliminated the curb (Table 7). Curb ramps were found at the two residential schools for children with vision impairment (GAB, WPSBC), but in neither case were warning strips and/or visual and tactile warnings used.

Signage: *Character height* was consistently observed to be 1" (Table 9). However, a wide range of *mounting heights* were found. The lowest was at MHS (37"), which is lower than the maximum height allowed in the Children's Supplement. No other signage was observed that was mounted as low or lower than the Children's Supplement maximum height of 40". The highest was at GAB (66"), which matches the upper limit of that allowed by UFAS. Braille signage at the GAB was mounted between 59" and 64" AFF. The lower signage installation height found at MHS placed information near eye level for young children and teenagers in wheelchairs. At the two residential schools for children with visual disabilities, braille and other tactile signage was conspicuous by its absence.

Drop-Off and Loading Zones: Passenger drop-off and loading was handled in a number of ways (Table 11, Photos 4-8). Several sites (GHPS and UCP) had long drop off zones to accommodate bus traffic. GHPS had a 240-0 long covered drop off zone that paralleled a one-way entry drive. The adjacent covered sidewalk created a continuous access aisle as there was no curb between the drive and the walkway. WPSBC had a covered drop-off areas with two smaller access aisles (one 5-0 x 7-0, and the other 5-0 x 10-0).

The long loading zone at GHPS was observed to work well when children at the Preschool as well as those at a Head Start program and the adjacent Elementary School arrived at the same time in the morning. Buses were able to pull to a free spot at the edge of the covered walkway that paralleled the drive with little if any waiting. In contrast, the drop off area at MHPS could only accommodate one vehicle (car, van or small bus) at a time. Congestion and a long cue resulted.

At the BCM, signage directed vehicles to handicapped parking and the accessible drop off area. However, it is very difficult for buses to turn around once in this area and experienced bus drivers reported they did not use this drop off area. Rather, disabled children were discharged at the street and approached the building from another direction.

The walkways adjacent to the vehicular portions of the unloading zones at WPSBC, GHPS and UCP were covered. At UCP, the canopy did not extend to provide protection. Children as well as staff were observed to get very wet while unloading during a rainstorm. At GHPS only the central section of the canopy covering the access aisle extended over the vehicular area. Although it was raised to accommodate buses and other tall vehicles such as fire trucks, it only covers one bus at a time. Further, the entire canopy was too high to keep rain from blowing in on the children.

Seating: Conventional auditorium space was not observed at any of the sites (Table 12). MHS had an auditorium but its design was oriented toward a large percentage of the floor space being occupied by wheelchairs with seating for individuals not in wheelchairs provided at the rear of the auditorium. As the UFAS specification for minimum floor space of 30"x48" per wheelchair is based on traditional spaces with fixed seating, the sites surveyed do not provide data to address this requirement.

Libraries and Media Centers: Only three sites had library facilities were evaluated at three sites: GAB, MHS, and WPSBC. The *maximum upward reach* required to use card catalogues ranged from 37" (MHS) to 66.5" AFF (WCS) (Table 13). The *maximum downward reach* was 8" AFF (WCS). The height of stacks at GAB was 69.5" AFF, and the top shelf was not used for storage. In contrast, stacks at MHS were 37" AFF.

No problems were reported or observed in conjunction with the libraries.

Classroom and Instructional Areas: The height of *wall mounted objects* ranged widely from 17" AFF (BCM), 24" AFF (GHPS) and 26" AFF (WPSBC), to 48" AFF (MHPS), 50" AFF (UCP) and 58" (MHS) (Table 14, Photos 15-17). These ranges represent heights that were much below or much above the maximum height of 36" in the Children's Supplement. *Minimum blackboard heights* also ranged widely from 6" AFF (GHPS) to 39.5" AFF (WPSBC). Blackboards at UCP (24" AFF), MHS (28" AFF), and BCM (29" AFF) equaled or were similar to the minimum height of 24" specified by the Children's Supplement. Staff at GPHS reported that the very low blackboard heights worked well for the young students in the program, whether they were used from a standing, sitting on a chair, or sitting on the floor position. The controls and other objects incorporated into educational exhibits at BCM that were mounted below 40" appeared to worked better for children in wheelchairs, many of whom had reach impairments.

The highest and lowest classroom lighting levels were observed at UCP (12 to 190 fc). At GAB and WPSBC the illumination levels ranged between 32 and 61 foot candles. At GAB, the classroom lighting could be adjusted to various levels in different parts of a room to meet the needs of individual students. At GHPS, the system incorporated incandescent as well as fluorescent lighting and overall light level could be adjusted for different activities. No problems were reported or observed with lighting levels in classrooms.

Work surface heights tended to be lower than that specified in the Children's Supplement (30" AFF maximum). The lowest work surface heights were observed at MHPS (17" AFF), UCP (17.5" AFF), and WPSBC (18.5" AFF). The most commonly observed work surface heights were between 23.5" and 25.5" AFF. The highest work surface heights were observed at BCM (37" AFF). Across sites, adjustable work surface heights, and/or work surfaces of a variety of heights seemed to work best in any given situation, accommodating children of different stature, working in a standing, leaning or sitting position (in wheelchairs as well as table chairs).

In addition, the number and placement of legs on tables presented problems in classrooms where there were a number of children in wheelchairs. At MHS, for example, tables with multiple legs caused excess maneuvering of wheelchairs and prevented some of the students from using some of the tables altogether.

Storage: The maximum observed *height* for storage used by ambulatory children ranged from a low of 40" (GHPS) to a high of 78.5" AFF (WPSBC) (Table 15). The height of *clothing hooks, clothing rods, and shelving* also varied widely. In general, the heights of storage at preschool sites was well below UFAS requirements (54" AFF maximum) and close to the 36" AFF included the Children's Supplement. It is clear that not all storage in settings that serve young children is at a height that is easy for them to reach. For example, storage at MHPS ranged from 5" AFF to 57" AFF.

The 40" height of the open storage cubbies worked well for young children. In contrast, the lowest bathroom shelving at GAB exceeded the UFAS maximum of 54" and was marginally within reach for some of the shorter children. The 72" high bedroom shelving at GAB too high for children to reach from a standing position. At MHS, some lockers had been modified with a low shelf 5" AFF that worked well for children in wheelchairs with reach impairments. The 43" high clothing hooks in these lockers were 7" higher than the maximum allowed by the Children's Supplement. The children were unable to reach them.

Toilets, Urinals and Toilet Stalls:*Toilet heights* ranged from 11" to 19.5". This is below the Children's Supplement range (15" - 17" AFF) and above the 17" - 19" range specified by UFAS (Table 16, Photos, 18-20). The lowest toilets were found, not surprisingly, at preschool sites (GHPS, 12" AFF; MHPS, 11" AFF). Sites that served older children and children of a variety of ages and with diverse capabilities to transfer tended to have toilets of a variety of heights. For example, at GAB toilets heights were observed that ranged from 14.5" to 19.5 " AFF. *Flush control heights* were similarly diverse (GHPS, 18"; GAB, 37" AFF). In most cases, controls were not only lower than the maximum height specified in UFAS (44" AFF), but also lower than the maximum included in the Children's Supplement. While *grab bars* were typically installed, their height varied widely across sites (MHPS, 16" AFF to MHS, 42" AFF). At five sites (GAB, MHS, WCS, RES and WPSBC) grab bars were installed at or near the range specified by UFAS (33-36"AFF). At four sites (BCM, GHPS, MHPS, and UCP) grab bar heights were at or below the heights specified in the Children's Supplement (25" - 27" AFF). *Toilet paper dispenser heights* tended to exceed the UFAS minimum of 19" AFF. *Distance from the rear wall*, tended to fall within the range specified in the Children's Supplement (18" - 24"). At GHPS, dispensers were lower (18" AFF) and closer to the rear wall (12" AFF), in part as a result of the small size toilets used.

At GHPS and UCP staff reported that the critical issue related to toilet height for young children was to insure that they were low enough for children to get their feet on the ground, which enhanced the children's sense of stability and body functioning. As most young children in wheelchairs were placed on toilets, toilet heights compatible with transferring was less of an issue for this age group.

At MHS children reported that 17" toilet seats (the high end of the range in the Children's Supplement) were too high for them to transfer; toilets seats at 16" AFF permitted them to transfer independently. At UCP, staff reported that toilets seats at 15.5" high were too high for preschoolers.

Grab bar heights were within the range specified by UFAS (33"- 36"), but were five inches or more higher than the UFAS Supplements recommendation for grab bar heights (25" - 27"). At GHPS and RES, observation and staff comments suggest that the critical issue in the use of toilet side grab bars by children under 8 or 9 years old is their distance from the toilet, not their height. Additionally, the toilet-side grab bars at GHPS were small in diameter, which staff reported children could easily grasp. The range of grab bar configurations used in conjunction with different toilet seat heights at GAB were reported to work well for children of different stature with different types and severity of orthopaedic disabilities.

Urinals were not widely used at the sites. Urinal *height* at two sites (GAB and MHS) exceeded the maximum height specified by UFAS (17" AFF). At GAB and MHS urinals of different heights were provided. *Flush controls* (38" to 48" AFF) were near or above the maximum height allowed by UFAS (44" AFF). No problems were reported regarding urinals at the two sites where they were found.

Toilet stalls were not provided at two of the three preschool sites. Where provided, stalls of different dimensions and configurations were observed across the sites. *Width and length* dimensions generally met or exceeded those specified by UFAS. Narrow, 36"-wide stalls with parallel grab bars as well as larger, more square stalls were observed. In all cases, *toe clearance exceeded* UFAS (9" minimum), and *clear floor space outside* ranged from close to the UFAS minimum to greatly exceeding it. *Door widths of* accessible stalls met or exceeded UFAS requirements.

At MHS, none of the children reported that they could complete a frontal transfer independently. Thus, the 36" stall was not suitable for them. The wide stall was preferred as it provided sufficient room for side transfers, transfer to a commode chair, or assisted transfers. In addition, there was adequate space for children with limited reach to approach the controls from the side and operate them.

Lavatories, Bathtubs, and Showers: In most cases, lavatories and sinks were at or below the maximum height specified by UFAS (34" AFF) (Table 17, Photos 21-24). At more than half of the sites at least one lavatory or sink was at or below the minimum height specified by the Children's Supplement (30" AFF). *Vertical clearances, knee space heights, and knee space widths* were typically at or near the minimums specified by the Children's Supplement. At four sites, *knee space depths* did not meet UFAS requirements, and at two sites did not meet Children's Supplement requirements.

Height of sinks and lavatories was found to be important in two ways. It not only affects the available knee space and vertical clearances, but it also affects the effective reaching distances to faucets and controls mounted at the back of the lavatory or sink. At MHS and RES, the children could not reach the faucets but they were able to pull their chairs under the sink. At MHS, to operate the controls they had to approach the sink from the side. At GHPS, staff reported that the accessible sink was too high for most of the ambulatory children to reach the faucet handles without a stepping stool. However, a child in a wheelchair would not be able to pull up to lower sinks and lavatories. The lever faucet handles mounted on the front apron of the art room sink at MHS work welled for children with limited reach and hand control. The front mounted faucet handles on the classroom sinks at GHPS worked well for preschoolers.

Clear floor space for bathtubs met or exceeded UFAS requirements. Some *grab bars* were installed at tubs in accordance with UFAS requirements (33" - 36" AFF). Others were installed two to nine inches lower (MHS, GHPS). No problems were reported or observed with tubs installed in accordance with UFAS. Staff at WPDSBC cited problems related to the height of tubs and transferring students into and out of tubs without a lift, which placed them at risk of back injury.

The most typical type of shower stalls observed at the sites were large (30" x 60" or larger) stalls with one or more shower heads (GAB, MHS, WPSBC). *Grab bars* were installed at GAB and WPSBC. They were installed higher (39" AFF) than specified in UFAS (33" - 36" AFF), and further away from the wall (2.75" vs. 1.5"). Except for one shower at GAB, *controls* were within the mounting height specified by UFAS (48" maximum). Only at MHS were they below the maximum specified by Children's Supplement (36"). Some shower stalls at GAB had *curbs* of 1.75"; some but not all had been beveled.

The size of shower stalls were reported to work well at all sites where they were present. At GAB, the shower stall grab bars were higher than UFAS. Staff reported that at this height children who stood for assisted bathing became anxious as they did not feel stable. Additionally staff reported that more grab bars were needed. Staff also reported that in showers used by children who required assisted bathing, controls should be high enough to prevent children from reaching them and accidentally scalding either themselves or the caregiver.

Drinking Fountains and Water Coolers: A variety of water fountains were observed across the sites including commonly seen wall hung units that were accessible and inaccessible for adults and some children in wheelchairs (Table 18). Important differences were the *spout heights* (29" to 38.5" AFF), *spout location* (front and side), and *type of controls* (bars, buttons and levers). In most cases, available *knee space* meet or came close to current Children's Supplement requirements for vertical clearance and depth. The water fountain at GHPS was nonconventional, mounted on the side toward the front of classroom sinks.

The water fountain mounted on the front of the classroom sinks at GHPS worked well for preschoolers. At WPSBC, staff suggested that drinking fountains at different heights were desirable. They also noted that some students have difficult operating the control and drinking at the same time.

Public Telephones: The *mounting height* of public telephones were close to or within UFAS requirements (≤ 48" to 54") except at WPSCB where public telephones were mounted at 26.5", which is lower than the 36" maximum included in the Children's Supplement (Table 21). No observational or self reported data were obtained relevant to public telephones.

Restaurants and Cafeterias: The only site with a traditional food service line was found at East Wake Middle School, one of two schools in the Wake County school system (WCS) visited for this project. At this site, *clear width* was more than one foot narrower than the UFAS minimum of 36" (Table 22).

CONCLUSIONS

Two types of factors impact the suitability/accessibility of design features in children's environments: characteristics of children and characteristics of the situation. Characteristics of children are related to age as well as the type of disability. Specific factors include:

- fine motor ability (such as the operation of controls),
- upper body strength (such as opening doors),
- reach in AP and ML planes (such as wall mounted objects or grab bars),
- stature (such as transferring to a bed),
- stamina (such as climbing ramps),
- balance (such as maintaining an upright position on a toilet), and
- skill level in negotiating the environment (such as maneuvering a wheelchair precisely.

Situational characteristics are specific to the facility that is, or will be used by children. Situational factors include:

- the number of disabled individuals using a facility; and
- the policies and practices of the institution (such as the height of switches and outlets).

Accessible Route: Wider accessible routes work well in children's environments for several reasons. They are necessary to avoid congestion and permit two-way traffic in settings where one might expect a number of children in wheelchairs. In addition, age-, and to some extent, disability-related differences between children and adults' skill levels require that facilities for children be provided with wider accessible routes.

Children's stamina also tends to influence the distances that they can traverse. This has important implications for the length of accessible routes at multi-building sites such as schools. It also should influence the number and location of accessible features such as elevators and ramps along the route. For example, one elevator at one end of a school may be insufficient if a student in a wheelchair has classes on different floors at the opposite end. This situation would, in effect, unnecessarily increase the length of the route that the student must traverse.

Ramps: Many children, particularly those in manual wheelchairs who have limited strength and stamina, experienced difficulties ascending ramps, even those that were within the UFAS specifications. As a result, at several sites, children were pushed up ramps by parents or staff. Moreover, staff at MHS maintained that a slope of 1:16 was required. Clearly, 1:12 is too steep as a maximum allowable slope for ramps that will be used by children

Although 36" is sufficient as a minimum clear width of ramps for a single wheelchair to maneuver safely, the minimum width should be considerably greater in facilities where a number of children in wheelchairs use the ramp at the same time. This will enable two-way traffic and can help to avoid congestion and accidents.

The data indicate that cross slopes that are greater than the 1:50 maximum allowed by UFAS are too steep. As there is no data that would call into question the 1:50 slope, it would appear to be sufficient at this time.

Edge protection was only observed at one site where it exceeded the UFAS minimum by 6". Children only had problems with the lack of edge protection at one site where their wheelchairs dropped off the side of the ramp. It is evident that edge protection is necessary, but there is no data to indicate that the UFAS minimum is inappropriate.

Stairs: Although no problems with the use of stairs (including tread width, riser height, and handrails) were observed, stairs, nonetheless, can pose a serious safety hazard for visually impaired and nonambulatory children whose skill levels in navigating the environment are somewhat less than those of young adults. Detectable warnings and/or barriers (such as the bollards at MHS) are needed at the top of stairs to prevent accidents.

Elevators: Operating controls are too high for many children as a function of body stature and reach. In addition, children with arm and hand impairments have even more difficulty in reaching controls. Call and car control buttons at all sites were higher than the maximum height permitted by the Children's Supplement . This suggests that the UFAS maximum of 34" and 36" for call and car control buttons, respectively are probably better suited for children with disabilities than the heights found in the sites evaluated. However, there is no data from the site visits to support the specification of these heights.

Finally, call control buttons are too small for many disabled children who have limited hand and finger control. In several instances, children had difficulty with using call control buttons that were 1" in diameter. This indicates that the minimum size of .75" specified in UFAS may be too small for some disabled children to use.

Doors: One of the most pervasive problems for children of different ages and with different types and severity of disabilities is pulling/pushing and holding doors open. Virtually all children, not just those in wheelchairs or with gait and balance disorders experienced difficulty in using doors. It is likely that the widespread existence of this problem is related to the influence of fire codes on doors specified for settings such as schools. It is clear, that doors that are easier to operate but do not violate other health and safety considerations are needed in children's environments.

Hardware on all doors exceeded the 36" maximum allowed by the Children's Supplement. Although children at MHS were observed having difficulty reaching hardware that was located at 45" AFF, staff at UCPDC reported that the hardware in their building which only exceeded the Children's Supplement by 3-5" worked well for both children and adults. This suggests that a maximum height somewhere between 36" (Children's Supplement) and 48" (UFAS) may be appropriate.

Two alternatives to hinged doors with automatic closers were examined in this project: magnetic door closers at Wake County Schools and automatic opening doors at West Pennsylvania School for Blind Children and the Gainesville Handicapped Preschool. In effect, doors that are closed need to be easier to open, or if they are left open, they need to be easier to close.

Drop-Off and Loading Zones: Loading zones compatible with the type and volume of vehicular traffic common at settings such as schools and museums are needed to avoid congestion and reduce waiting time. Further, access aisles should be provided for the number and types of vehicles that the loading zone is designed to accommodate. Covered walkways between the loading zone and the accessible entry are desirable. Canopies need to be low enough to offer protection from blowing rain and high enough to permit access by school buses and emergency vehicles.

Classrooms and Instructional Areas: Although the Children's Supplement sets a maximum height of 30" for work surfaces, only two sites had heights greater than 25.5". Height, in and of itself, however, was not as important as the provision of work surfaces at a number of different heights. Adjustable work surface heights, and/or work surfaces of a variety of heights seemed to work best in any given situation, accommodating children of different stature, working in a standing, leaning or sitting position (in wheelchairs as well as table chairs).

In settings where there are a number of children in wheelchairs, the location and number of legs on tables pose problems. Although pedestal-type tables would help to avoid problems experienced by children in wheelchairs, this style of table may not be stable enough for children who need to lean on the table for support.

Storage: The 40" high storage at GHPS seemed to work well for ambulatory preschoolers. However, 43" was too high for older nonambulatory children at MHS. this indicates that shelves and hooks could possibly be higher than 36", although how much higher is not clear. Certainly 43" is too high. Furthermore, the most appropriate height of storage is influenced by body stature, body position, and forward and upward reaching capabilities of the child. It is unlikely that fixed storage heights will work for a cross section of children. Adjustable shelving of different depths is a viable option to this problem.

Toilets, Urinals and Toilet Stalls: Age and independence in toileting influence the suitability of different toilet seat heights. Among young children the critical issue related to toilet height is to insure that the toilet is low enough for them to get their feet on the ground, which provides a sense of stability and improves body functioning. As most young children in wheelchairs were placed on toilets, toilet heights compatible with transferring was less of an issue for this age group. For this group of children heights of 12" at GHPS and 11" at MHPS seemed to work better than the 15.5" height at UCPDC. These heights are considerably lower than the 15"-17" recommended by the Children's Supplement.

In contrast, among older children who transfer with or without assistance from a wheelchair, the critical issue is the height of the toilet in relation to the height of the child's wheelchair. At MHS, the children reported that the 17" high toilet (the maximum height allowed by the Children's Supplement) was too high. However, the great variability in the size of children's wheelchairs complicates this issue.

The use of toilet side grab bars by children with age- or disability-related reach limitations is related to their distance from the toilet, more so than their height. Different grab bar configurations work well for children of different stature with different types and severity of orthopaedic disabilities.

The 36" toilet stall is not suitable for many children who could not perform a frontal transfer. A wider stall is more suitable as it provides sufficient room for side transfers, transfer to a commode chair, or assisted transfers. In addition, this type of stall provides adequate space for children with limited reach to approach the controls from the side and operate them.

Lavatories, Bathtubs, and Showers: The suitability of sink heights are related to age and type of disability. Very young ambulatory children need sinks that are lower than those needed by nonambulatory children of a similar age and stature. This is evidenced by the difficulty that ambulatory children at GHPS had with using the 30" high lavatory. In contrast, nonambulatory children could not get their wheelchairs under sinks that were lower. This suggests that the minimum height of 30" specified in the Children's Supplement is only adequate for nonambulatory preschool children.

In addition, children with reaching problems and those who are small in stature experience difficulty operating controls that are located at the back of sinks and lavatories. This problem is exacerbated for children who are also in wheelchairs. Faucets and controls that are moved to the front of the sink are more accessible to more children.

Finally, the location of controls on lavatories, tubs and showers is dependent on decisions related to the amount of independence children should have. In some cases (e.g., when a child needs attendant care), it may be more appropriate to put controls out of the reach of children in order to ensure their safety.

Table 1
Accessible Route

UFAS REFERENCE	UFAS	ATBCB Sup	Florida Std.	BCM	GHPS	GAB	MHPS	MHS	RES	UCPDC	WCS	WPSBC
4.3.3 Width	36" - 48"		44" - 102"	138"	84"	64"-95"	84"-96"	45"-112"	108"-112	43" - 70"		64"
4.3.4 Passing Space	60" every		60" every							none		60"
	200' max		100' max							none		200'
4.2.1 Wheelchair Passage	36" min									NA		36"
	(32" at point)											32"
4.2.3 Wheelchair Turning Space	60" diameter									60"		60"
	60" T turn											60"
4.2.4.1 Clear Floor Space	30" X 48"									30"X48"		30"X48"
4.2.5 Forward Reach	48" max											78.5"
	15" min											2.5"
4.2.6 Side Reach	54" max									0" - 49.5"		78.5"
	9" min											2.5'
4.3.8 Changes in Level	max 1/2"		max 1/2"									NA
Vertical	≤1/4"		≤1/4"						1/2"			NA
1:2 Bevel	1/4" - 1/2"		1/4" - 1/2"									NA

LEGEND
BCM - Boston Children's Museum
GHPS - Gainesville Handicapped Preschool
GAB - Georgia Academy for the Blind
MHPS - Massachusetts Hospital Preschool
MHS - Massachusetts Hospital School
RES - E. Rivers Elementary School
UCPDC - United Cerebral Palsy Developmental Center
WCS - Wake County Schools
WPSBC - Western Pennsylvania School for Blind Children

Table 2
Ramps

UFAS REFERENCE	UFAS	ATBCB Sup	Florida Std.	BCM	GHPS	GAB	MHPS	MHS	RES	UCPDC	WCS	WPSBC
4.8.1 Minimum Slope	1:20		1:20	1:12	None	1:12	None	1:29	1:20	None	1:16	1:13-1:19
4.8.3 Minimum Clear Width	36"			48"-138"		48"-120"		45"-116"	42"		127"	41.5"-85.5"
4.8.2 Maximum Slope	1:12		1:12-1:20	1:09		1:10		1:09	1:10		1:12	1:04
4.8.6 Cross Slope	≤ 1:50		≤ 1:48								1:24-1:48	
4.8.4 Landing Length	60" min		60" min								59"	
4.8.4 Landing Width	ramp width		ramp width			96"x50"			42"		127"	
4.8.7 Edge Protection (Drop Off)	2" min		2" - 30"			0		8"	NA		0	0
4.8.5 Handrails Required	rise > 6" run > 72"		> 6"			Varied Varied						
4.8.5 Railing Height	30" - 34" AFF	26" - 28" AFF	30" and 24"	34"		30"-36"		32"	30.75"		32"	32"-34"
4.8.5 Railing Extension	12"		12"	18"		0			0"		13" (top)	13"-31"
4.8.5 Wall to Railing	1 1/2"		2"	5"-9"		1.5"			NA			1.5"-2.5"
4.21.2 Diameter of Railing	1 1/4" - 1 1/2"		1" - 1 1/4"	2"		1.5'x3'		1.5"			2" - 6"	1.5"-1.75"

Table 4
Stairs

UFAS	Reference	UFAS	ATBCB Sup	Florida Std.	BCM	GHPS	GAB	MHPS	MHS	RES	UCPDC	WCS	WPSBC
4.9.2	Treads	≥ 11"		11"	12"	No stairs	11.5"	No stairs	No stairs		No stairs		12"
4.9.3	Projections	1 1/2" max		1" max	1"								1"
	Relative Riser Height			6-3/4"	6"-7"		5.5"						
4.9.4	Handrail Height	30" - 34" above nosing	26" - 28" above nosing	30" and 24"	30", 37" 16", 27"								34.5"
	Warning Strips			36" deep; 36" X tread width			None						None
	Illumination			≥ 20 ft.candles									7.5-8 fc
	Steps			min 3/rise	6		16						8

Table 5
Elevators

UFAS Reference	UFAS	ATBCB Sup	Florida Std.	BCM	GHPS	GAB	MHPS	MHS	RES	UCPDC	WCS	WPSBC
4.10.2 Cab to Floor Landing	1/2" max		1/4"	0	No elev.	No elev.		0		No elev.		9/16"
4.10.3 Call Buttons	42" CL	34"	34" - 36"	43"				40.5"	38.5"		42.5"	43"
4.10.3 Call Button Minimum Size	3/4"		1" and 2" O.C.	1"				1"	1.25"sq.		1"	1 1/16"
4.10.4 Hall Lanterns	72" CL 2 1/2" in smallest direction		60" CL 2 1/2" in smallest direction						44.5"		80.5"	94"
4.10.5 Hoistway Entrance Markings	60" CL	By designer	42" CL	56"				41"	60.5"		60"	60"
4.10.8 Door Delay	min 3 secs		min 10 secs									8 secs
4.10.9 Minimum Door Width	36" min			48"				48"				
4.10.12 Car Control Buttons	54" max	36" max	36" max	50"				52"			39.5"	46"
4.10.12 Emergency Buttons	min 35"		min 23"	40"				44"			35"	34"
4.10.14 Emergency Communications	48" max	36" max	36" max-23" min					44"			28"	NA
4.10.1 Phone Cord Length	29" min		36" min								36"	NA

Table 6
Doors

UFAS Reference	UFAS	ATBCB Sup	Florida Std.	BCM	GHPS	GAB	MHPS	MHS	RES	UCPDC	WCS	WPSBC
4.13.5 Minimum Door Width	32"		36"	32"-37"	28"-48""	29"36"	33"-41"	33"-45"	33 7/16"	32"-36"		35.5 - 60"
4.13.6 Maneuvering Clearance	Fig. 25		48" - 60" length width of door plus 18" width	60"+	56"-64"	32"-95"	18"+	18"+		41"		36"-103" plus 24"
4.13.7 Doors in a Series	48" and door width if swing into space		48" and door width if swing into space	75"								
4.13.8 Thresholds - Exterior	3/4" max height		1/2" max height	0		.5"-1"	0	0	.5"	.75"-1"		NA
4.13.8 Thresholds - Interior	1/2" max height		1/2" max height	1/2"		.25"-1.5"	0	0		.25"		1/4"
4.13.9 Door Hardware	48" max	36" max	30" - 34"	34"-40"		38"-40"		37"-45"	38"-40"	39"-41"		38"-41"
4.13.10 Closer Time	3 sec min		20 sec		motion sensor							
4.13.11 Force - Exterior	reserved		5 lbf	1-9lbf	5-15lbf	10-16lbf	2lbf	8lbf	10lbf	10.5-11.2lbf		
4.13.11 Force - Interior	5 lbf		5 lbf	6-10lbf		3-12.75lb	1lbf	3lbf		2.25-12lbf		6 - 6.5 lbf

Table 7
Curb Ramps

UFAS Reference		UFAS	ATBCB Sup	Florida Std.		BCM	GHPS	GAB	MHPS	MHS	RES	UCPDC	WCS	WPSBC
4.7.1	When Used	at curb		any drop > 1/2"		None	None		None	None		None		
4.7.7	Warning Strips			12"min depth				None						None
4.7.7	Visual and Tactile Warnings	reserved		yes				None						None

Table 9
Signage

UFAS Reference	UFAS	ATBCB Sup	Florida Std.	BCM	GHPS	GAB	MHPS	MHS	RES	UCPDC	WCS	WPSBC
4.30.4 Size - Height	5/8" - 2"		5/8" - 2"	1"	NA	1"		1"				
4.30.6 Mounting Height	54" - 66"	40" max	42" max	50"		63"-66"		37"-55"				59"
Braille mounting height			Braille			59"-64"						

Table 11
Drop-Off and Loading Zones

UFAS	Reference	UFAS	ATBCS Sup	Florida Std.	BCM	GHPS	GAB	MHPS	MHS	RES	UCPDC	WCS	WPSBC
4.6.5	Access Aisle or Passenger Drop Off & Loading Zone	5' X 20'	12' X 50'	12' X 60'	0	8'X240'	None				14-1.5 X 19-4.5		5' X 7' - 5'X10'
	Drop-Off to Building			100'		44' min							NA

Table 12
Seating

UFAS	Reference	UFAS	ATBCB Sup	Florida Std.	BCM	GHPS	GAS	MHPS	MHS	RES	UCPDC	WCS	WPSBC
4.2.4.1	Clear Floor Space for Wheelchairs	30" X 48" min		(Forward) 33" X 48"min (Side) 33" X 60"min		No fixed seating			No fixed seating		No fixed seating		No fixed seating
	Between Seats			18" - 24" min									
	Table to Wall Distance			42" min	5'-6"								

Table 13
Libraries and Media Centers

UFAS Reference	UFAS	ATBCB Sup	Florida Std.	BCM	GHPS	GAB	MHPS	MHS	RES	UCPDC	WCS	WPSBC
8.4 Card Catalogs - Clear Width	36"			No lib.	No lib.					No lib.		NA
8.4 Card Catalogs - Reach	48" preferred 54" max 18" min	36" max				40"		37" 29"			66.5" 8"	NA
8.5 Stacks - Clear Width	36" min 42" preferred					36"						NA
8.5 Stacks - Height	unrestricted					69.5"		37"				NA
Light Level - Table Top						51fc						
Light Level-Card Catalogue						35.2fc						

Table 14
Classrooms and Instructional Areas

UFAS	Reference	UFAS	ATBCB Sup	Florida Std.	BCM	GHPS	GAB	MHPS	MHS	RES	UCPDC	WCS	WPSBC
	Wall Mounted Objects		36" max		17"-58"	24"-48"		47"-48"	36"-58"		50"		26"-44"
	Minimum Blackboard Height		24" min		29"	6"			28"		16"-24"		39.5"
	Lighting - Classrooms					33-85fc	32-61fc		40fc		12-190fc		39"- 49 fc
	Tables & Work Surfaces - Width			30"	15"-26"		36"						NA
4.32.4	Tables & Work Surface - Height	28" - 34"	30" max	25" - 30"	25"-37"	20"-25.5"	25"	17"	29.5"-35"		17.5"-23.5"		18.5"
4.32.3	Arm Rest Clearance	27"	24"	27"	12"	19"-24.5"	20"		29"-31"		16.75"-22.75"		17.5"
4.32.3	Knee Space - Depth	19"	19"	19"	15"-26"		20"		28"-33"				NA
4.32.3	Knee Space - Width	30" min	30" min	36"min			27"		48"				NA

Table 15
Storage

UFAS Reference	UFAS	ATBCB Sup	Florida Std.	BCM	GHPS	GAB	MHPS	MHS	RES	UCPDC	WCS	WPSBC
4.25.2 Clear Floor Space	30" X 48"		30" X 48"			52"x54"						32"X82.5"
4.25.3 Height	54" max		36" max w'chair 46" max amb		40"	59"-72"				13.5" 45.5"		78.5"
4.25.3 Clothes Rods	54" max		40" max					31.5"-53"		NA		75.5"
Clothes Hooks		36" max	36" max		36"	56"		43"		34"		59"
Sheives		36" max					5"-57"	2"-45"				78.5"

Table 16
Toilets, Urinals, and Toilet Stalls

UFAS Reference		UFAS	ATBCB Sup	Florida Std.	BCM	GHPS	GAB	MHPS	MHS	RES	UCPDC	WCS	WPSBC
4.16.3	Toilet Height	17" - 19"	15" - 17"	10" - 15"	16.5"-18"	12"	14.5"-19.5"	11"-17"	14"-18"	19.5"	15.5"	19.5"	16.5 - 19"
4.16.4	Grab Bar Height	33" - 36"	25" - 27"	24" "	29"-34"	24"	32"-37"	16"-23"	34"-42"	no back	26"	33"	32 - 34.5"
4.16.5	Flush Controls	44"	32" max	≤30"	24"-27.5"	18"	19"-37"	21"	23"-25"	26"	25.5" - 25.75"	26"	25.5 - 28"
	Operating Force					4lbf	14-34lbf				16.5lbf		
	Toilet Paper Dispenser												
	Height	19" min to CL	19"	18" CL	20"-32"	18"	20"-49"	26"-32"	19"-29"	27.5"	24"	26"-39"	22 - 24.5"
4.16.6	Dist. - Rear Wall		18" - 24"		13"-26.5"	18"	5"-30.5"	16"	14"-24"	36"	24" - 25"	30"-36"	24 - 36"
	Urinals					None					None		None
4.18.2	Height	≤17"					17.5"-28.25"		14"-24"			15"	
4.18.3	Clear Floor Space	30" X 48"					67"x71"					14"	
4.18.4	Controls	44" max	32" max				38.5"-45"		48"			38"	
	Toilet Stalls										NA		
4.17.3	Width	36",48",60"		48",60"	31"		27"-35.75"	32"-55"	33"-71"	30.5"		36"	38.25 - 48"
4.17.3	Length	56", 59"		60", 72"	55.5"		58.25"-78"	28"	56.5"-72"	71"			30 - 71"
		98" min		100" min									
4.17.4	Toe Clearance	9" min		18"			11.75"-12.25"			11"			12.5 - 19.5"
4.17.3	Clear Space Outside	42" - 48"		48"			40"-114"			3'-0"x5'-0"			48"
4.17.5	Door Width	32" clear		36"	33"		21.5"		35"	32"			32"
4.17.6	Grab Bars - Height	33" - 36" CL	25" - 27" CL	Varies			37"		32"-36"	33"			

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Table 17
Lavatories, Bathtubs, and Showers

UFAS	Reference	UFAS	ATBCB Sup	Florida Std.	BCM	GHPS	GAB	MHPS	MHS	RES	UCPDC	WCS	WPSBC
	Lavatories & Sinks												
4.19.2	Height	34" max	≥30"	≥30"	31"	22"-30"	28.25"-37.5"	28"	26"-34"	28"	24"-34"	33"	32"-38.5"
4.19.2	Vertical Clearance	29" min	24" min	27" min	22.5"	20"-27"	24"-30"	25"	23"-29"	25"	30"-30.25	29"	28-28.5"
4.24.3	Knee Space Height	27" min	24" min	27" min	27"	12"-20"	20.5"-28"			22"	26"	26"	25"-29"
4.24.3	Knee Space Width	30" min	28" min	30"			25.5"-71"	25"	36"	9.5"ft		Inf	46"
4.24.3	Knee Space Depth	19" min	17" min	8" - 11"	23"		10.5"-26"	18"	20"-27"	15"	9"	18"	23"
4.19.2	Toe Space		6" max X	6" X 16"	13"		6.5"-10			unlim.	16" - 17"	9'	11.5"X15"
			9"high max	high min									
	Front to Faucet						14.5"-21"	14"	11"				
4.24.4	Bowl Depth	6 1/2" max					6.5"-7"			5"	6" - 8"	6"	6"-6.5"
4.19.6	Mirrors - Bottom Ht	40"	30"	34" max	30"	21"-36"	32.75"-46"	35"	34"-40"	none	48"-49"	40"	40.5"
				tilted > 30"									
	Illumination					5-50fc	50-75fc						
	Grab Bars			vertical to 4"							NA		NA
				above sink at									NA
				side									NA
	Bathtubs										NA		
4.20.2	Clear Floor Space	30" - 48" wide		48" wide		36"	31"-97"		36"				29" wide
		60" - 75" long		60" - 75" long		75"	60"-126"						78" long
4.20.4	Grab Bars - Top	33" - 36" CL		24" - 28" CL		24-28	35"-37.5" ell		30"-31"				34.5"
4.20.4	Grab Bars - Bottom	9" above		4" - 5" above			33"-52.5" ell						
		tub rim		tub rim									
	Showers					None					NA		
4.21.2	Shower Stalls	36" X 36"		36" X 36"			36.75"x46.5"						NA
4.21.2	Roll-In Showers	30" X 60" min		30" X 60" min			46"x72"		32"x60"				36"X78"
4.21.3	Seat Height	17" - 19"	15" -17"	12" - 15"			16"		16"				19"
4.21.4	Grab Bar												
	Height x Length	33-36x var					39"x49"						
	From Wall	1.5					2.75"						
4.21.5	Controls Height	48" max	36" max	36" max			46"-51"		32"-35"				40.5"- 41"
4.21.6	Hose Length	60" min		72" min			58"						84"
4.21.7	Curbs	0" - 1/2" max		4" max			1.75"		0				
4.21.6	Fixed Shower Ht												
4.21.5	Hose Connection												59"

Table 18
Drinking Fountains & Water Coolers

UFAS	Reference	UFAS	ATBCB Sup	Florida Std.	BCM	GHPS	GAB	MHPS	UHS	RES	UCPDC	WCS	WPSBC
4.15.2	Spout Height	36" max	30"		29"-40"	24"	38.5"-43.75"		28"-37"	33.5"	None	38"	35.5"
4.15.3	Spout Location	Front			front	front	side		front				front/side
4.15.4	Controls Loc. & type	Front or side		Blade/push bars	bar	front/lever	front/button		button				push bars
	Force to operate					2-3lbf	5-7.25lbf			4.5lbf			
	Knee Space					mounted							
4.15.5	Vertical	27" min	24" min	27" min	31"	on sink	27.75"		20"-30"	26"		30.5"	26"-29"
4.15.5	Depth	8" min	8" min	17" - 19"	8"		18.25"		13"	7.75"		7.75"	10"-19"
4.15.5	Width	30" min		36" min	11"		17.25"			18"		52"	18.5"-19"
4.15.5	Toe Space	6"d X 9" m hig	6"d X 9" m high				9.5"-22"			10"		10.25"-15"	NA

Table 19
Controls & Operating Mechanisms

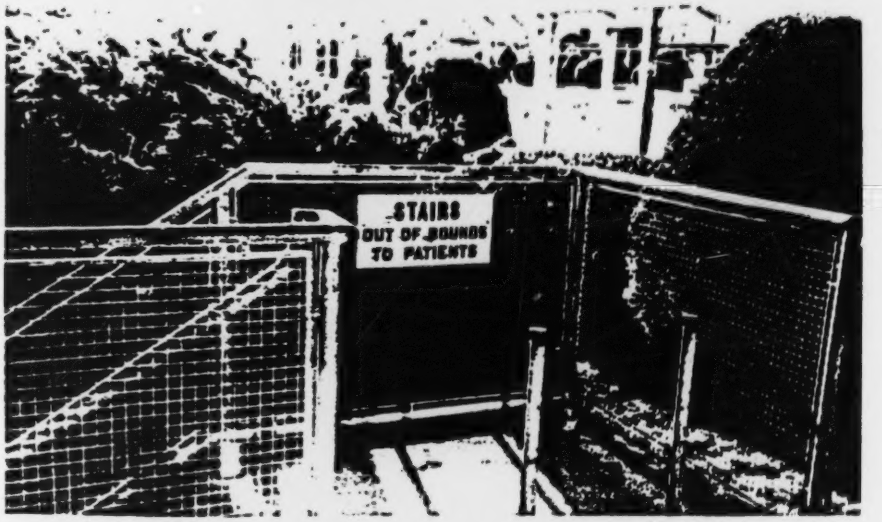
UFAS Reference	UFAS	ATBCB Rev.	Florida Std.	Ga Blind	Fla Pre K	Cobb Elem	Pa Blind	F'ville Pres	Rsl 3	Mass Hos Sc		Kids Museum
4.27.2 Clear Floor Space	30" X 48"		36" X 48"				NA	NA				
4.27.3 Height	48" - 54" 9" - 15" min	36" max 20" min	36" max "				21.5"-44"	13.5" - 49.5"				
							38.5" (alarms)	49" (alarms)				

Table 21
Public Telephones

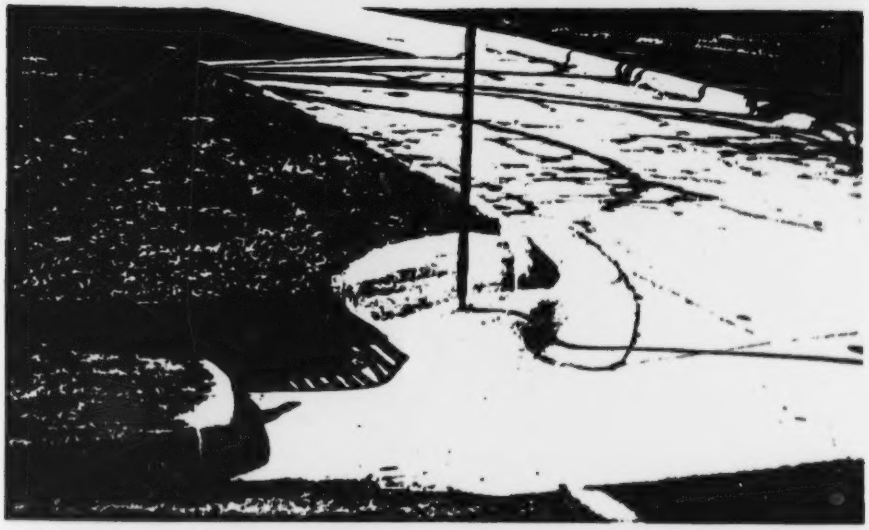
UFAS	Reference	UFAS	ATBCB Sup	Florida Std.	BCM	GHPS	GAB	MHPS	MHS	RES	UCPDC	WCS	WPSBC
4.31.2	Clear Floor Space	30" X 48" min		30" X 48" min			Variable						
4.31.3	Mounting Height	top ≤ 48" - 54"	36" max	36" max	47.5"		56.5"		44"-53"				26.5"
4.31.8	Cord Length	29" min		36" min	27.5"		32.5"						27"

Table 22
Restaurants & Cafeterias

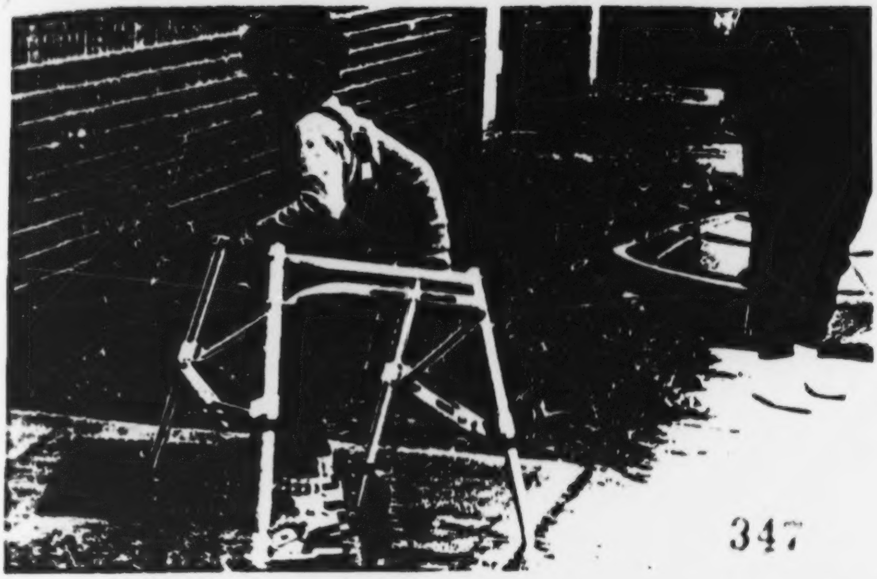
UFAS Reference	UFAS	ATBCB Sup	Florida Std.	BCM	GHPS	GAB	MHPS	MHS	RES	UCPDC	WCS	WPSBC
Food Service Lines					None	None	None	None				None
5.2 Clear Width	36" min 42" preferred		44" min								23"	
5.2 Tray Slides	34" max	30" max	30" max								35.5"	
5.2 Self Service Height	54" max 9" min	36" max	30" max								54"	
5.2 Forward/Side Reach		12" max	12" max									
Knee Space Under Tray Slide			27" min								12.5"	



1. ***Mass. Hospital School.*** **Bollards at head of stairs protects children who are learning how to use wheelchairs.**



2. ***Georgia Academy.*** **Storm drain grate is a trip hazard, although innovative deign was done for safety.**



3. ***UPCDC, Spring Lake.*** **Child has difficulty maneuvering casters on narrow, uneven concrete path.**

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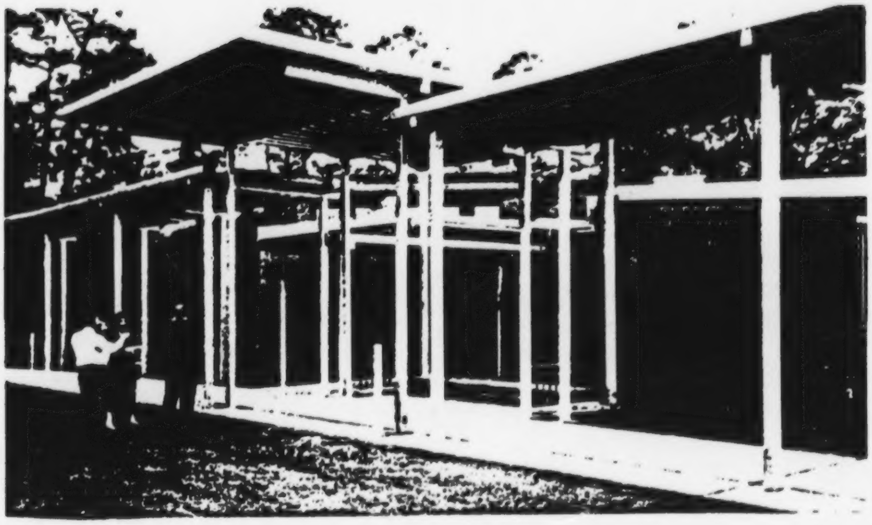
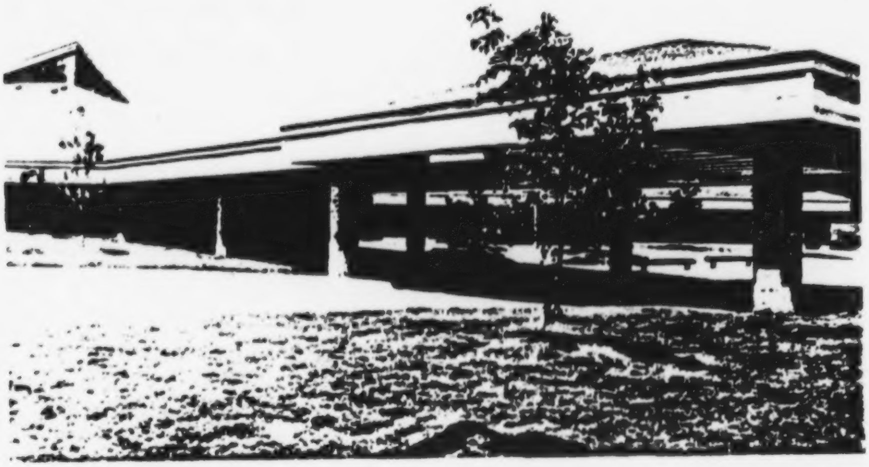


4. ***Gainesville Pre-School.*** **Generous drop-off and entry area. High part of canopy covers buses, but walkway canopy is too high to protect from driving rain.**

5. ***Vance Elementary School.*** **Covered drop-off zone.**



6. ***East Wake Middle School.*** **Long main entrance ramp built to minimum UFAS standard is difficult to use and has no protection from inclement weather.**

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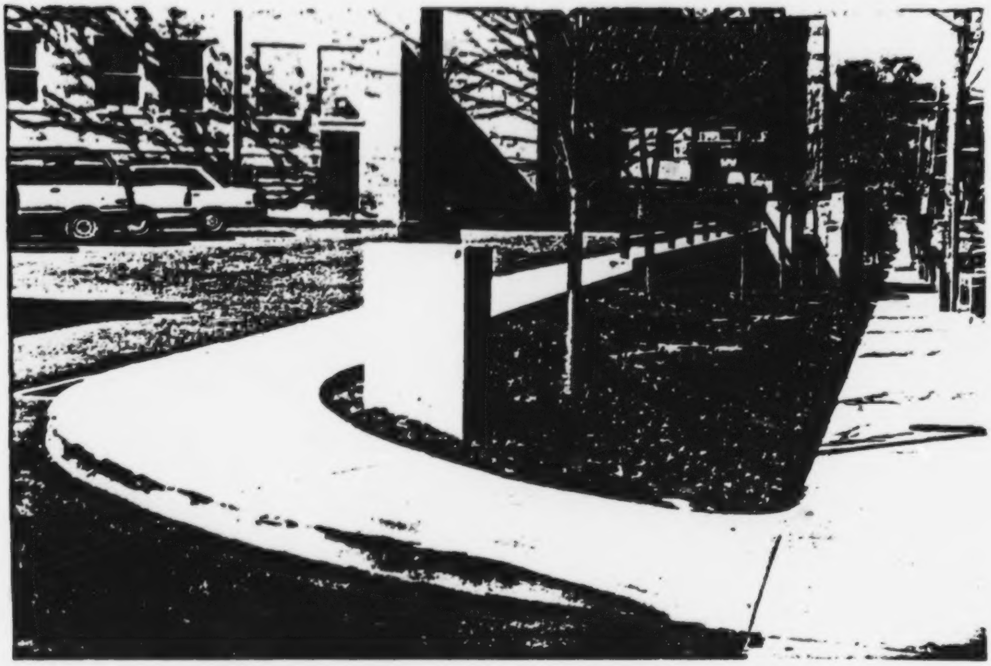
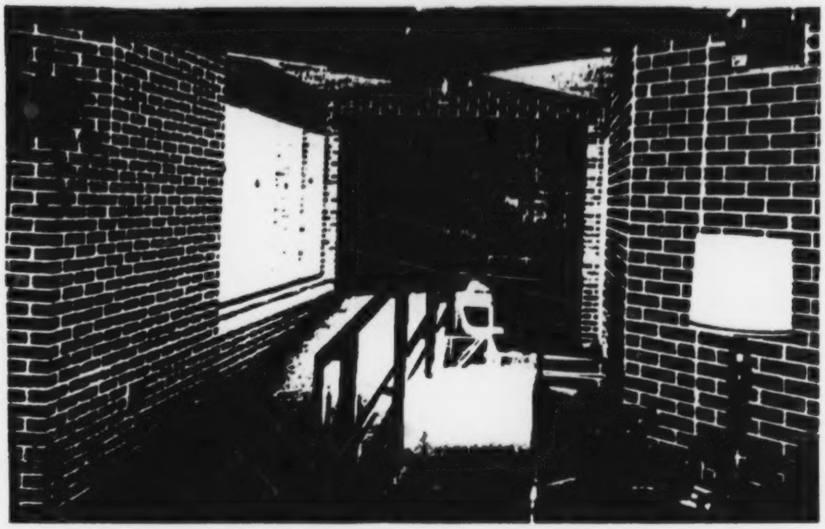
7. ***Gainesville Pre-School.*** **Entry to dorm building.**

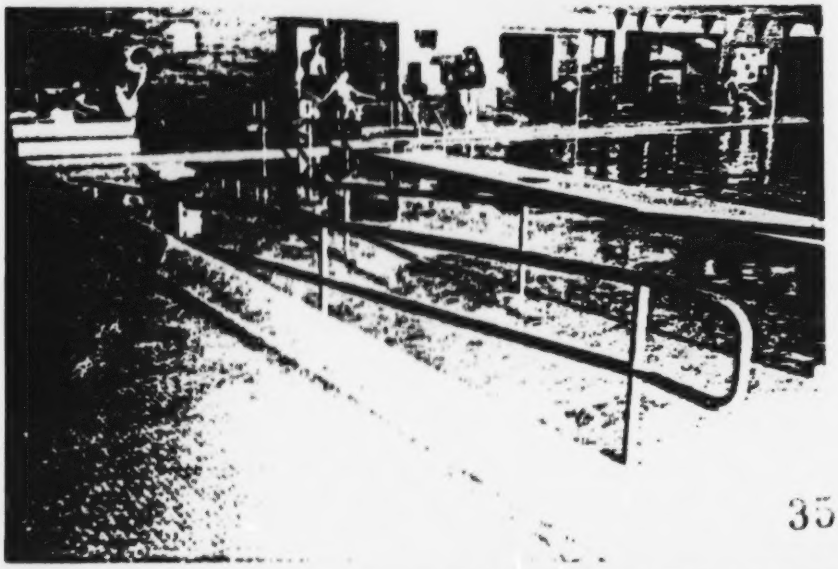


8. ***West Penn.*** **Hazardous cross slope at the junction of the accessible route with public sidewalk.**

9. ***Mass. HospitalSchool.*** Large ramp.



10. ***Georgia Academy.*** **Half flight of stairs replaced with a ramp when the building was rehabilitated.**



11. ***Mass. Hospital School.*** **Access ramp to the pool.**

12. *Gainesville Pre-School.* Main entrance power door.

13. *East Wake School.* Firedoor with magnetic release.

14. *Georgia Academy.* Awkward door openings that make maneuvering difficult in ensuite residential accommodation.

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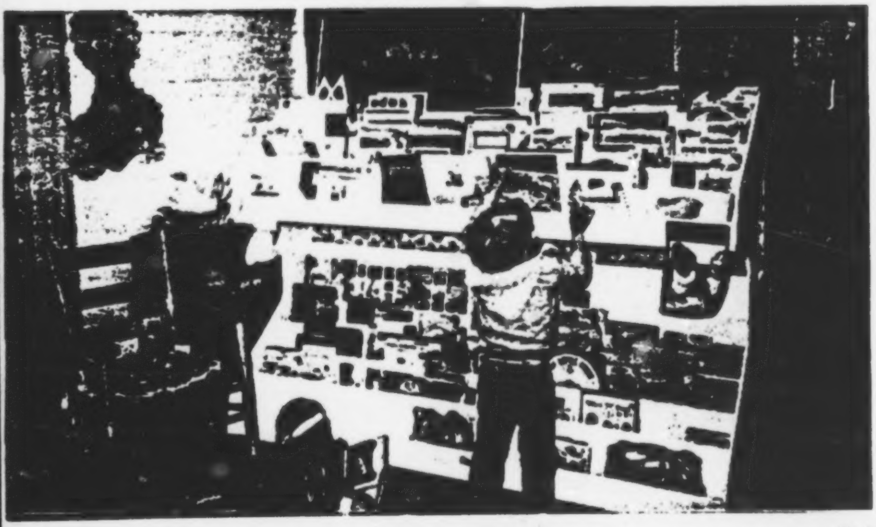
Housekeeping
Center



15- 17. ***Gainesville Pre-School and UCPDC, Spring Lake.*** **Furniture and materials arranged for easy access by preschool children.**

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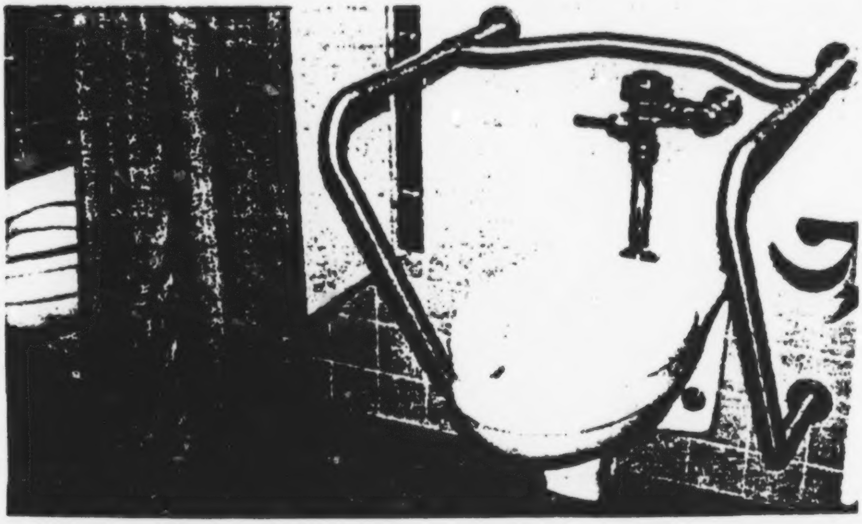
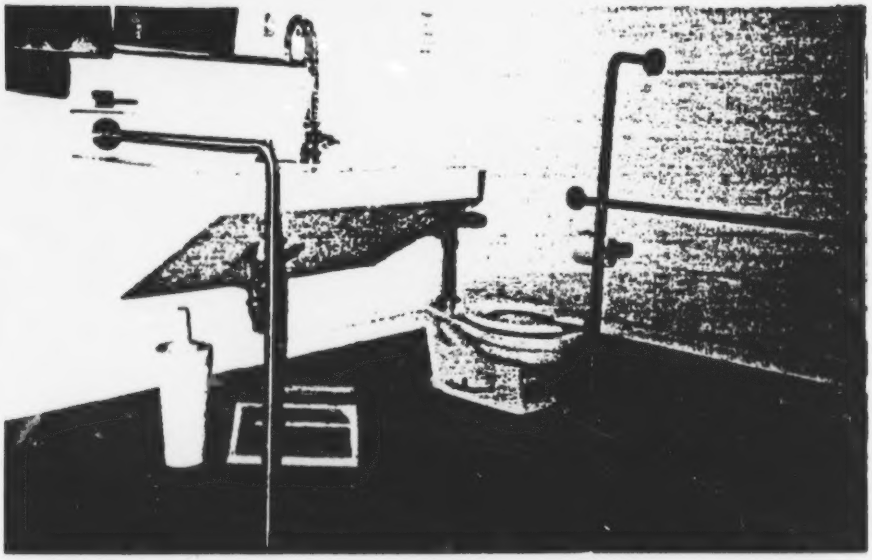
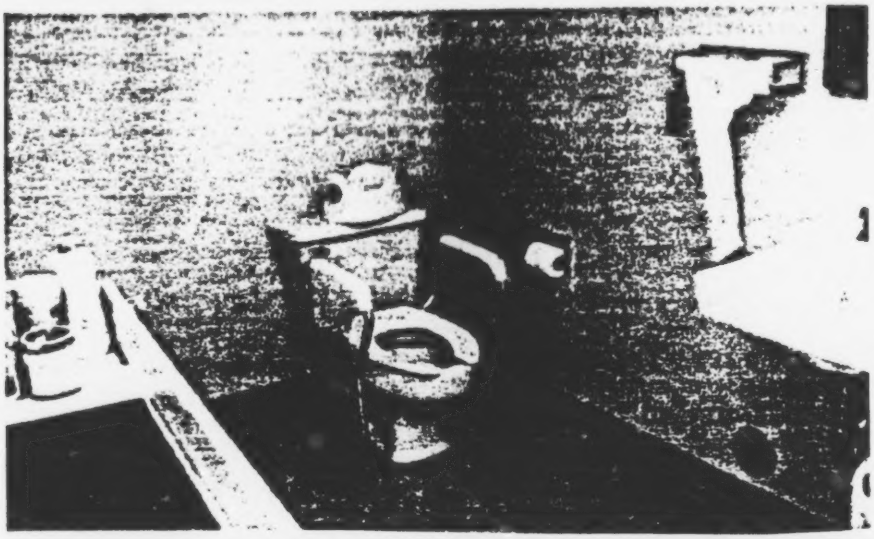


18. *West Penn.* Non-UFAS grab bar configuration that worked well for children -- and would work well for adults, too.



19. *Gainesville Pre-School.* Foreground: Lavatory set too high for the 3-5 year-old users who had to use the stool set under. Background: low toilet for 3-5 year-olds (low height allowing feet to touch the floor gives a feeling of security which is more important than the possibility of transfer (especially during toilet training). Note the small diameter grab bars suitable for preschool hands (the vertical bar worked well for both sitting and standing).



UPCDC, Spring Lake. Conventional toilet.

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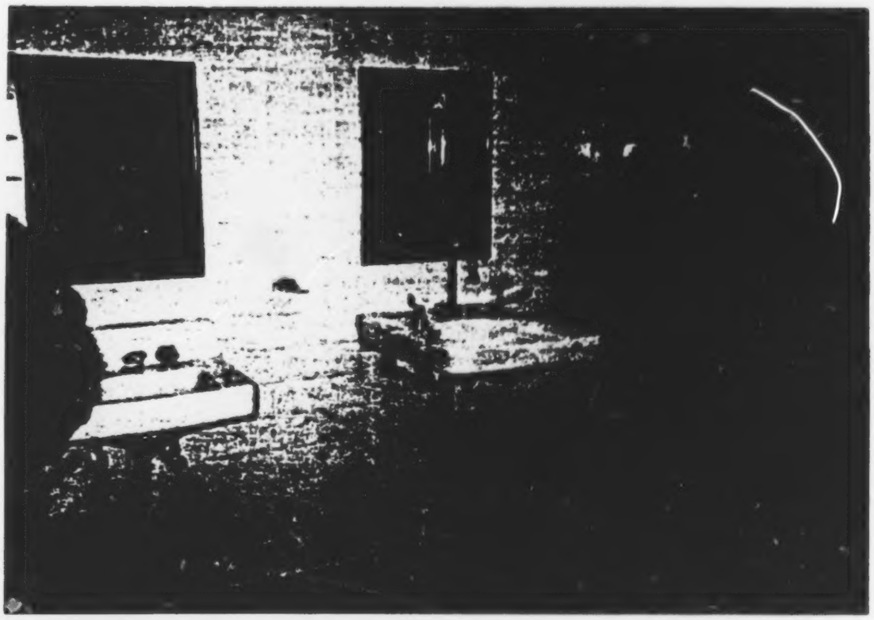
21. **Gainesville Pre-school. Sink with front-mounted faucet and drinking fountain that work well. The faucet, however, is too high so that water runs down the users' arm.**



22. ***Georgia Academy.* Side-by-side comparison of conventional lavatory (left) and accessible lavatory (right). Note the mirror is set too high to be accessible to children using wheelchairs.**

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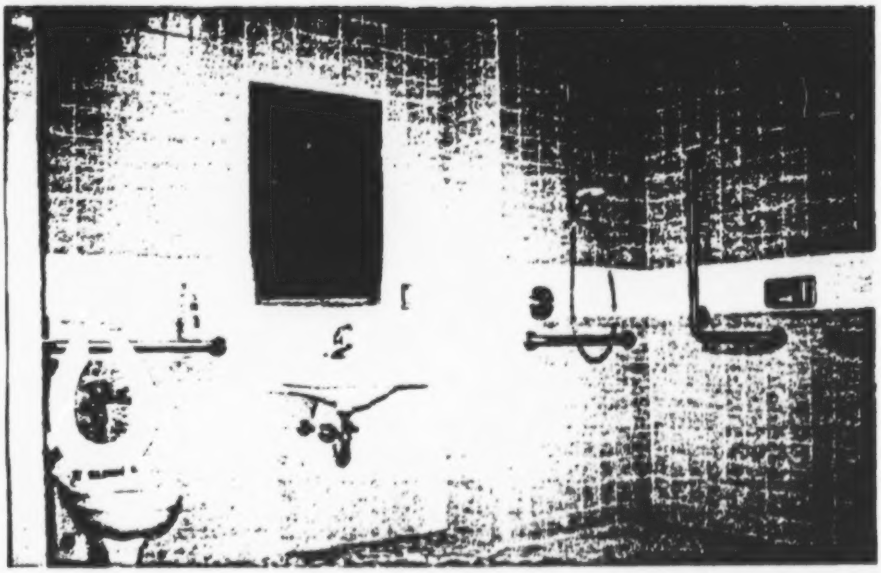
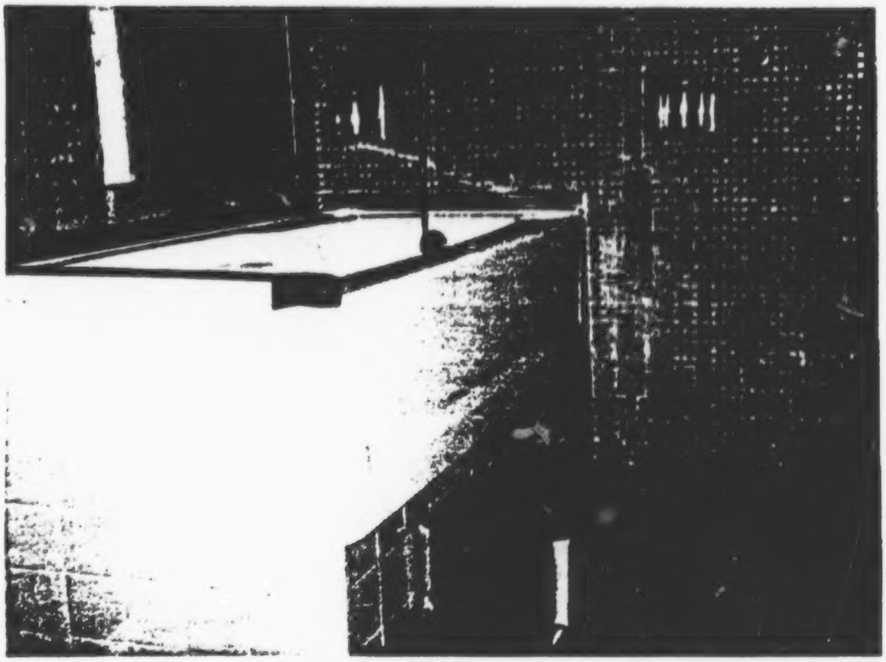


23. ***West Penn.*** **Hand-held shower. Abundant grab bars improve security for the user.**



24. ***Mass. Hospital School.*** **High tub that used to be used to bathe young children, now presents an awkward and hazardous situation for older users.**

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THE CHILDREN'S MUSEUM
BOSTON, MASSACHUSETTS

Site Description

The Children's Museum is located in late nineteenth century renovated brick and timber warehouse on a wharf on Boston's waterfront. Winner of the 1986 Best of Accessible Boston award for renovated buildings, the museum occupies 35,000 square feet on four floors. Planning is now underway for a major expansion onto the wharf area.

The Museum was founded in 1913 by a group of university and classroom teachers who believed that learning need not be confined within four classroom walls. The museum has been the model for participatory children's museums throughout the world. It is the second oldest children's museum in the country and the third oldest in the world. Its exhibit, "What If You Couldn't...an Exhibit about Disabilities", developed by the staff has toured nationally under the auspices of the Smithsonian Museum. One of its publications, "Is There Life after 504" was a useful tool for organizations who wanted to implement non-discriminatory programs in response to the federal law Section 504 of the 1978 Rehabilitation Act.

The museum currently has 15 major exhibits spread over the four floors as well as a teacher resource center and a museum store. The exhibits vary widely in scope. They are all designed to facilitate maximum interaction with children as individuals and sometimes in groups. Each exhibit is planned to be self instructional, and children are encouraged to find their way into and through each exhibit. One area, "Playspace", was created especially for toddlers and preschoolers. More recently a Clubhouse area was created for children nine through fifteen. Some other exhibits are: "The Kids Bridge", a multicultural exhibit created to foster cultural diversity; "Waves and Vibrations" which explores wave formation through manipulation of objects in water, soap film and other materials in several engaging water play areas; "Raceways", which demonstrates motion and momentum through the use of balls speeding down a roomful of tracks. There is the "Japanese House", an authentic, two-story, full-scale installation of a silk merchants home from Kyoto and "Ahead to the Past", a section of a three story Victorian House. "Climbing Structure" is a 2-story suspended sculpture which encourages full scale physical activity as children (five and older) crawl up and down. "What If You Couldn't" provides opportunities to try out riding wheelchairs, grasping objects, and some other experiences of disability. In addition, on any given day there are special activities in conjunction with many of the exhibits. The museum is staffed by "interpreters", whose role is to facilitate interactions as needed.

Population Description: More than 750,000 children and adults use the museum's programs and visit its exhibits annually. One quarter million teachers and community workers are served by the Resource Center programs.

Children come with their families, friends or in school groups. With state support, schools send children throughout the school year. Children with disabilities participate as part of integrated groups of children who attend the museum as well as through a special time set aside on Wednesday mornings for groups with special needs. This program was originally designed to allow more time and space for children with disabilities to enjoy the activities of the museum. The Wednesday program has also been used as a training opportunity for teachers to work in a challenging and stimulating environment with children who have disabilities. This past year 1,800 children with disabilities have participated in the Wednesday program. Untracked, but reported by the Special Needs coordinator, Nona G. Silver, hundreds of other children with disabilities attended as part of other school groups or with families.

The most frequent users are children from kindergarten through third grade; next are fourth to sixth graders. The least frequent users are children who are younger than five and those twelve through fourteen, in about equal numbers. No records are kept on the types of disabilities represented among children who use the museum. However, staff perceptions are that among children with disabilities who come to the museum, the most frequent type of disability is learning disability. Almost no children with vision limitations use the museum. Children with walking disabilities are seen somewhat more often.

Facility Description: The museum has a wide center staircase which divides the floors into two major areas. Each floor has a number of bays, with installations that may have many freestanding or built in components. There are several multi level exhibits that have their own interior staircases and which can be entered on different floors. An elevator at one end of the building is used by people with accessibility needs. However, at the entrance lobby, this elevator is not apparent; it is beyond a door which could be a service door and the signage for the elevator is a rather worn painted sign on the floor. This is the only signage or non-signage condition that we noted. Since every one entering is greeted by some reception staff, the Children's Museum personnel don't see the need for any other signage. This is not an entirely adequate situation since some people may have disabilities which are not apparent to the greeter. Another problem with the elevator location is that on each level, the entire floor must be traversed to get back and forth to the elevator.

Accessibility was an issue in the Japanese house, which has a stepped bridge entrance. "It wasn't culturally consistent", but a ramp was installed to provide another entrance at the side. This controversial decision was negotiated with the state access board.

Lighting is an important element which varies from area to area; there is a definite design to the lighting to create the desired ambiance for the particular exhibit. In some areas it is fairly dim, other places are brightly lit. There is a concern expressed by staff for children with low vision. At the meeting with staff we learned that the flashing lights for the new "Kids Bridge" had to be shut down because they set off seizures for one or more people. We have no information about the frequency of the flashing lights.

Signage is another strong design element, both to set the theme and to communicate. The staff discussed their graphic standards and the use of larger type, at least one inch high "which is good for everyone" and placed lower for an audience that is, on average, six years old. It was noted that lowered signs are for the parents and teachers. Also, Children's Museum designers avoid "violent" colors except in oversize area signs.

One exhibit looks as if it might never be used by children with disabilities. This is the dramatic two full story "cage" climbing structure. It has narrow, multilevel crawl spaces and is carefully designed to keep the maximum falling distance to a minimum. Four of the children wanted to experience this and were carried in, one at a time, by a Mass Hospital staff person. They could move a little, but their ability was restricted by the number of other children climbing through. One child thought it might be a good idea to be able to crawl around in there, "without all those other kids who weren't handicapped".

There are accessible toilets on each floor as well as inaccessible toilets. The inaccessible toilets don't have the enlarged stall but they do have sinks at two levels and lever hardware.

Data Collection Approach

The Museum was of interest because of its creative history and the opportunity it presented for another unique building type. The administration of the museum has had a long standing relationship with Adaptive Environments, so there was ease in beginning the planning. The museum staff was also interested in the study and hoped to learn more about how to make their facility more usable by diverse children. Scheduling a group of children was a potential problem, given that we wanted the children to have time to visit the museum as well as meet with us and then do some additional observations. This would be difficult in the usual two hour visits for school groups. In reviewing the scheduled list we found that there was no group who was scheduled to visit the museum during a study period who met our criteria of age, physical disability and communication skill, nor was the length of their visit adequate for our purpose.

We decided to invite the children from the Mass Hospital School to visit the museum for the purposes of this study. This was the only way we could assure the availability of a group of children that we wanted to observe. The staff at the Mass Hospital School was enthusiastic about the study and were able to arrange transportation. The children were also very enthusiastic; at least four of them had been there before and were eager to go again. The date which was selected was not a "Special Needs" day; the children would be there in and among large groups of children. Everyone was agreeable to that; we thought it would offer a more realistic appraisal of use in a public museum setting.

The naturalistic observation began with the entrance to the museum, up the boardwalk ramp and continued through much of the visit. The children did their explorations and we observed, took notes and video taped; they were aware of our recording but seemed very engrossed in the activities. After the lunch meeting we asked if anyone wanted to visit the "What if you couldn't" exhibit; that was as structured as we got.

The timing of the visit was established by the arrival and departure times of the school busses for some of the participating children who were day students. They would arrive at the Children's Museum at 10:00 AM and leave at 2:00 PM. They brought a picnic lunch so that we could have our children's meeting right after lunch and have the maximum time for the children to use the museum.

In planning what we might observe, we spent some prior time visiting the museum and meeting with the museum staff. We identified some areas that we thought would be especially interesting but soon decided that we'd just observe the children wherever they choose to go. We knew that we would have entrances, exits and reports of toilet rooms; the rest would be chance. The museum staff had some specific interest in observing the children at the "What if you couldn't" exhibit...and luckily two of the children wanted to see that. We planned to video wherever we could; there would be no simulations.

The measurements were taken during and after the visit, trying to match that data collection with what the children did as well as to gather some basic access features which may or may not have been used by the children.

Several of the museum staff asked that the children's meeting be audiotaped so that they could hear the children's comments. The meeting with museum staff was scheduled to be held after the children left. Participants were: the exhibit design director, administrative manager of exhibits and programs, the operations director of visitor services, the special needs coordinator, the operations manager, the graphic design director, and the director of public programs. The meeting was one hour long and provided an opportunity for an exchange on access questions; the museum staff had some concerns and some sensitivity regarding exhibits which weren't totally accessible. They were relieved and pleased that the children had so many positive experiences. They were surprised that the climbing cage was so popular; it was brought up by one staff person to point out that "everything can't be accessible".

Findings

Accessible Routes: At the Children's Museum (CM), there is only one exterior accessible route, a wooden boardwalk. The boardwalk ranges from 11'-6" at its narrowest point at the ramp to 13'-0" at the approach to the entrance. Bollards at the base of the ramp are placed apart 39" clear. None of

the children mentioned, nor were observed, having any difficulty with the pathway. When asked about the 1/2" gaps in the boards, they believed that these did not present any obstacles to their mobility. Because of the path's width there were no designated passing spaces.
Generally, the *interior routes* of circulation were open exhibit spaces with greatly varying width dimensions. Consequently those areas which seemed to be "pinch points" in the circulation space were focused on. None of the students from the Mass Hospital School who were interviewed after using the CM mentioned, nor were observed to have, any difficulty in route width.

The Kid's Bridge had passageways 48" wide (Figure 1); the Faultless Jamming guitar booth consisted of a stand with four guitars in the middle of a booth, with the narrowest point between the stand and the wall 28"; the Recycling Shop by storage bins, with the narrowest aisle 29" and the Mind Your Own Business exhibit had an exit point 29" wide. None of the students were observed to have any difficulty negotiating any of the passageways. The Recycling Shop, which consisted of 38" high barrels for the display of recycled goods, was an area of particular concern, because of the narrow width and the height of the barrels.

The narrowest parts of the accessible routes in the CM were either openings between areas, or spaces that required slow movement (as at the Recycling Shop). Also, even though the students had little difficulty in their maneuvering in the Recycling Shop, a wheelchair permitted no other passage. The difficulty which could be anticipated is when anyone needed to pass a person in a wheelchair, which is not possible in a 36" space. Most spaces in the CM were open, and most exhibits had *floor space* allowances exceeding those required by UFAS. Even in the Recycling Shop, which had relatively narrow aisles (29", 30", and 42"), wheelchair users were seen to negotiate the space easily. The one area where students complained of insufficient floor space was the Clubhouse Computer room, which had a 4'-8" entryway and a 5'-6" space between the front of the computer table and the opposite wall (Figure 3).

The discussion of *reach* ranges is covered under Controls. Many spaces by controls had dimensions that were less than 60" wide. For example students who were small in stature or in small wheelchairs were observed having some difficulty seeing into the barrels (photo 2). One non-control mechanism area where reach was an issue was the Recycling Center. The top of the bins was 38" AFF, and one short student who was a wheelchair user had difficulty seeing and reaching into the bins. The lower rack of materials was set at 20" AFF, with a reach down to 14", but none of the students said they had any problems with these.

There were two areas where *changes in level* made an exhibit inaccessible: the Kids' Bridge, and the Japanese House. The central feature of the Kids' Bridge (an exhibit focusing on racial prejudice) was a bridge that looks like a ramp, but was actually entered by two steps on either end. Although the Japanese House exhibit was ramped, some rooms are entered by one or two steps down. The students expressed particular frustration at being unable to use the Kids' Bridge. In terms of the code, this was a scoping, more than a dimensional issue.

Ramps: The ramps at the CM were the front entry ramp (1:12), the ramp up to the Dance Floor (1:8) (Figure 4), the ramp to the Japanese exhibit (1:12) (Figure 5), and the ramp up the fourth floor Rest Area (1:11). Only the Dance Floor ramp presented any problem due to its excessive slope and lack of handrails (although students all mentioned the Dance Floor as one of their favorite exhibits). The front ramp was 25'-9" long, and did not present any difficulties for children with power chairs. One of the three girls in manual chairs travelled up herself; the other two were pushed.
The only ramp designed for more than one wheelchair was the front exterior ramp, which had 11'-6" clear width. The Dance Floor ramp was 60" wide, and the Rest Area ramp was 48" wide. Each ramp was the only means of entry to the space. The children observed using the narrowest ramp used the full space--there would not be room for anyone to pass them.

Only the exterior ramp had any handrails. These were placed at 34". The lack of rails was a particular problem at the Dance Floor. One child nearly fell off the stage while trying to wheel himself onto the ramp which was parallel to the stage. Other children were observed having difficulty wheeling themselves up the ramp, which, as noted, was 1:8.

Railing diameter was 2", which is larger than allowed by either UFAS or Florida. The exterior rails were 5" and 9" away from the wall, which was also greater than UFAS or Florida standards. We did not observe any children using the handrails.

Stairs: All stairs at CM had slanted risers which projected 1". None of the students were ambulatory, therefore there were no observations of the stairs in use.

The exterior stair had two *rails*, 30" and 16" above the nosing; the interior main stair had two rails at 27" and 37" above the nosing. None of the children we were with used the stairs.

Elevators: *Call buttons* were 1" in diameter and were posted at 43" above the floor. These were within UFAS limits and higher than Florida standards. Children could not reach the button and felt they were too high.

The *controls* within the elevator cab were posted so that the lowest button was 36" AFF, and the highest was at 42". UFAS specifies a maximum height of 54". The *emergency button and emergency communications* were at 40" AFF. UFAS specifies that emergency buttons must be a minimum of 35" AFF. We observed one student with limited arm reach who was able to reach the controls with little difficulty. Two other children were able to use them with some difficulty.

Doors: *Minimum clear opening widths* range from 32" in UFAS to 36" in the Florida Standard. With one exception, all doors at the CM were wider than UFAS standards. Clear openings for the exterior entry doors were 37"; clear openings for the interior entry doors were 32" and 34".

All doors had greater than 5'-0" *maneuvering clearance* and 18" latchside clearance. All doors had latchside clearance of well over 18" and maneuvering clearance depth greater than required in Figure 25 of UFAS or in the Florida standard.

The only *threshold* in the CM was at the entrance to Faultless Jamming and was 1/2" high (Figure 6*)*. It presented some difficulty to the Mass Hospital School students. This was an unusual situation, since a sound barrier was required at the base of the door. The children in power chairs had to move very slowly in entering the small enclosed area, and this may have contributed to their difficulty.

Door handles throughout the CM was either loops or push bars, all located between 34"-40" AFF. Both types worked for the students.

The *force to open exterior doors* at the CM varied greatly. Some had an opening force of 9 lbs., and these were very difficult for the students to open. Doors which weighed 5 lbs, and were therefore compliant with UFAS standards, were also difficult to open.

Signage: Signage in the exhibits varied greatly in *height*. Most of the exhibit signage was higher than the UFAS, ATBCB, or Florida standards but had very large letters with high contrast. The one sign that did cause difficulty was at the Faultless Jamming booth, which was 50" AFF and had white letters painted on clear lucite. Many children found this difficult to read because of lack of contrast and excessive glare. T

Drop-Off and Loading Zones: The drop-off area at the base of the exterior ramp, which was 26' wide, had no designated *access aisle*. It was within 100' of the entrance. There needs to be more specifications in the code for places used by large numbers of children. The larger bus didn't pull in because he had gotten stuck there on a previous trip. There is limited bus turning space.

Classroom and Instructional Areas: At the Children's Museum there are many varied types of *controls* which may stretch the intent or scope of UFAS. All of the interactive exhibits required some manipulation of action on the part of the user. There were computers which had operating mechanisms including touch screens, keyboards, and track balls. The keyboards were usable by all of the children without any difficulty. The track ball was difficult for two of the boys who tried it, since it requires more fine motor control.

Most *wall-mounted objects* consisted of operable exhibit controls, which varied greatly in height from 17" to 58" AFF (Figures 7 and 8). The exhibit on water waves had several operable stations with handles set between 33"-36" AFF, and these worked well. The Hangman Computer game, which had a touch-operated screen with the highest point 43" AFF was popular with the students (Figure 9). Some wall-mounted items, such as literature, were placed at varying heights. The Kids' Bridge pamphlets were located 56" AFF, and could not be reached by the children. The Treasure Hunt pamphlets were set at 34" AFF, which was accessible to all of the children.

One child with full reach was able to reach all of the wall-mounted handles in the "What If You Couldn't ?" exhibit. All of the mounted controls had the full 36" x 48" clear floor space dimension recommended by Florida, which allows good maneuvering space. Other exhibits which were at table tops had adequate knee space.

The *work surface heights* also varied greatly, from 25"-37" AFF. A turtle tank, visible from above and below, had its vertical casing 34"-40" AFF, which blocked visual access (Figure 10). The Clubhouse computers were set on tables at 33" AFF, and that height worked well (although there were problems with floor clearance).

Toilets: There were two different types of restrooms at the CM, accessible and non-accessible. Each type was consistent on different floors, although there was not an accessible restroom on every floor. The *toilet heights* in the non-accessible bathrooms were 16.5" AFF, and in the accessible bathrooms 18" (Figure 11).

Grab bars were 29" AFF in the accessible bathrooms, and 34" AFF in the non-accessible. UFAS stipulates that grab bars should be placed between 33" and 36" AFF. Therefore, CM grab bars were lower than standard.

Flush controls were 24" AFF in the non-accessible, and 25"-27.5" in the accessible. This is well below the UFAS maximum of 44".

Toilet paper dispensers were 32" AFF in the non-accessible and 20"-23" in the accessible, and were located 26.5" from the rear wall in the non-accessible and 13"-14" in the accessible. This is within the UFAS standard.

The accessible bathrooms were single-use, but the non-accessible were divided into stalls of 31" x 55.5". Toe space was 13" AFF..

All bathrooms had clear space in excess of 5 foot square. *Door openings* were 33" on all rooms.

An issue related to toilets but currently not covered by the code involved the need for space for three of the girls to be catheterized by the nurse. This had been arranged in advance so that they could use the first aid room.

Lavatories and Sinks: *Sink rims* were at 27" and 34" in the non-accessible bathrooms (Figure 12) and 31" in the accessible bathroom.

The sinks were set at varying *heights from the floor* but constant *knee space* of 22.5" AFF. In the accessible bathrooms knee space was 27" AFF.

Mirrors were placed with their bottom edges at 38".

Drinking Fountain and Water Coolers: *Spout heights* varied between 29" to 40" AFF. All spouts were located at the front of the unit. *Controls* were all button or push-bar type.

All units were cantilevered off the wall. *Knee space height* varied between 31" AFF and 20" AFF. *Toe space* always exceeded the 9" required by UFAS, and knee space depth always exceeded the 8" required. We did not observe any children using the water fountains.

Public Telephones: The public phones in the lobby were mounted at 47.5" AFF to the coin slot, had 27.5" knee space height, and had 27.5" cords. Floor space exceeded the 30" x 48" minimum required by UFAS.

Conclusions:

Accessible Routes: Observing the several children in chairs who wheeled up the ramps simultaneously we saw the need for more frequent passing space than UFAS requires. In places where children gather we recommend the Florida Standards.
The UFAS minimum pathway width does not allow two people to travel side by side nor does it allow for people passing each other. We found that the lack of passing space presented a problem at the Children's Museum and believe that the CM data show that the Florida Standard of 44"-102" is preferable to the UFAS standard of 36"-48" in all situations.

Similarly, the UFAS minimum standards of 60" T *turning area* is sufficient for one wheelchair, but not where multiple wheelchairs are in use simultaneously. We suggest that the standards should show configurations and floor layouts.

Children have more limited reach ranges than adults. Our observations at the Children's Museum , together with the Control data, indicate that the UFAS forward reach standard should be lowered to ±44", and the side reach to ±48".

Ramps: Based on the comments regarding the slope and width of ramps at the Children's Museum and at the Mass Hospital School, we recommend the Florida standard as the basis for further research.

For handrails, the Florida Standard of two rail heights at 30" and 24" is preferable to having one compromise rail height.

Elevators: The UFAS standard is too high based on observations of the children trying to use the elevator emergency buttons. For call buttons and emergency controls in elevators and at elevator landings, the Florida standard of 34"-36" would be usable by most of the children, but UFAS would not.

Doors: Having no thresholds in interior doors is preferable to even a 1/2" bevelled threshold.

Both loops and push bar door handles can be used by children. However, as previous discussion of reach ranges suggests, the UFAS maximum height of 48" is too high. The ATBCB suggestion of 36" would appear to be more appropriate.

For door weight, it appears that both the UFAS standard and Florida standard of 5 lbs. are excessive and should be reduced to 3 lbs. maximum.

Signage: Children has problems reading some of the signs at the museum. This indicates that additional requirements relating to high contrast and low glare should be added.

Drop-off and Loading Zones: The lack of an access aisle and the limited bus turning space created problems at the drop-off and loading area. We suggest that configurations be added to show how busses and vans may use drop-off areas and that guidelines be developed for further detail options.

Classrooms and Instructional Areas: Children had difficulty with some of the interactive controls, particularly with the track balls used on some exhibits. MHS teachers suggested that a joy stick would be better.

From our observations, we infer that wall-mounted objects above 40" would be reached by difficulty, if at all, by the children. The ATBCB suggestion of 36" AFF is on the right track, and therefore we suggest a range of 36"-40" for wall-mounted objects.

We saw no difficulty with the height of work surfaces, nor was any reported. We recommend 25"-34", a mix of both the Florida and the UFAS standard. Ideally, tables would be adjustable.

Toilets: We found that several children needed space to be catheterized by a nurse. Space for special medical procedures in toilet areas is currently not addressed in the code. Our recommendation is that in any school and possibly in any facility in which people will spend more than an incidental amount of time, that there be a room or stall which would allow room for medical procedures which require assistance.

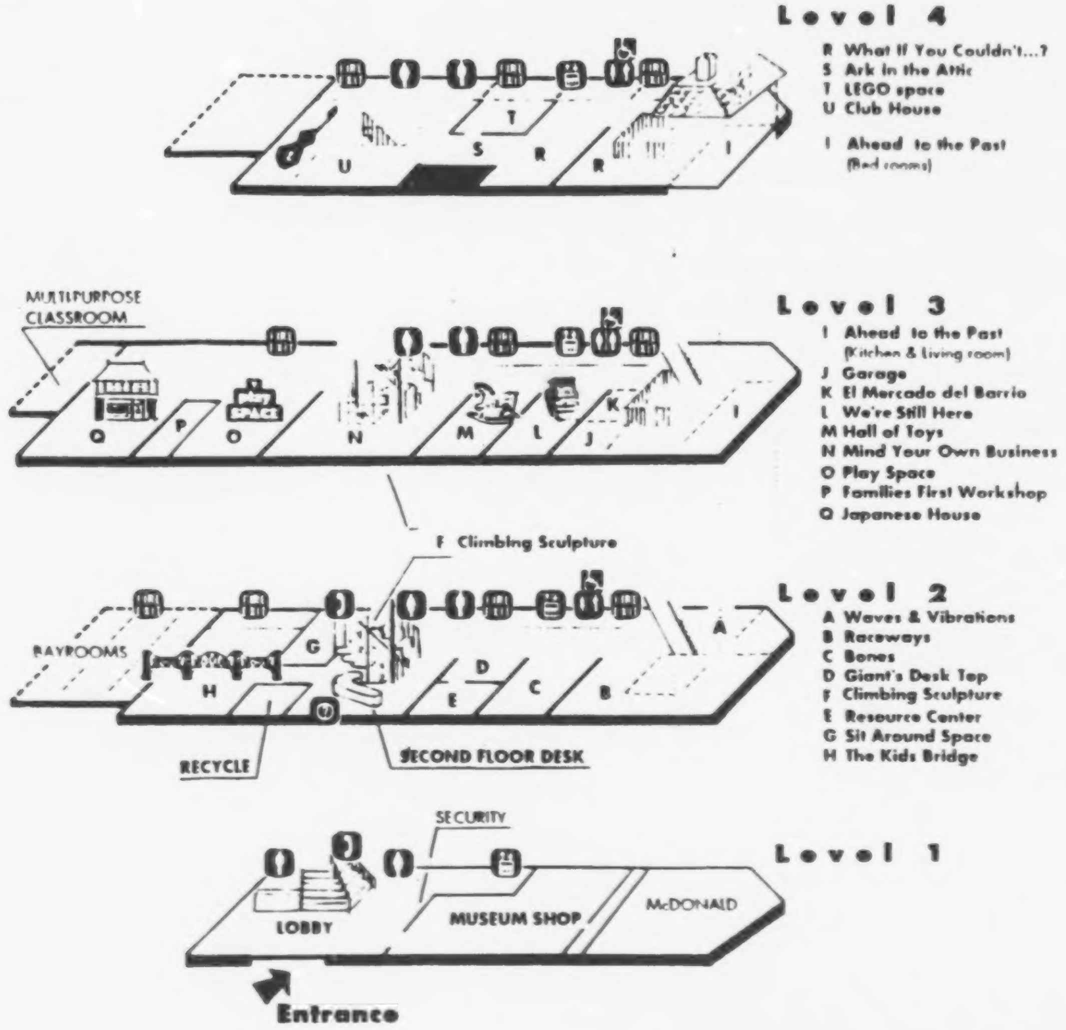
Level 4
R What If You Couldn't...?
S Ark in the Attic
T LEGO space
U Club House
I Ahead to the Past
(Bed rooms)
U
S
R
R
T
I
MULTIPURPOSE CLASSROOM
Level 3
I Ahead to the Past
(Kitchen & Living room)
J Garage
K El Mercado del Barrio
L We're Still Here
M Hall of Toys
N Mind Your Own Business
O Play Space
P Families First Workshop
Q Japanese House
Q
P
O
N
M
L
K
J
I
F Climbing Sculpture
Level 2
A Waves & Vibrations
B Raceways
C Bones
D Giant's Desk Top
F Climbing Sculpture
E Resource Center
G Sit Around Space
H The Kids Bridge
BAYROOMS
G
H
D
E
C
B
A
RECYCLE
SECOND FLOOR DESK
SECURITY
Level 1
LOBBY
MUSEUM SHOP
McDONALD
Entrance

Figure 1. Floor Plans of Children's Museum

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PRESCHOOL HANDICAPPED CLASSROOMS
STEPHEN FOSTER ELEMENTARY SCHOOL
ALACHUA COUNTY SCHOOLS
GAINESVILLE, FLORIDA

Task One of this project identified a new standard for children's environments promulgated by the Florida Department of Education, *Building Standards for Educational Facilities for Handicapped Children*. The new standard is intended to ensure that the "design, construction and alternation of new and existing prekindergarten, kindergarten and primary grade educational facilities ... meet the needs of young handicapped children from age three through grade three in Florida's public schools." The Preschool Handicapped Classroom Facility at Stephen Foster Elementary School in Gainesville is the only facility designed in accordance with these standards that has been completed and occupied to date.

Site Description

The Preschool Handicapped Classroom Facility is a free standing facility built on the site of the Stephen Foster Elementary School. The facility was planned for 14 students, aged three to five, two teachers, and three aides. It was anticipated that program specialists such as physical therapists, and occupational therapists also would use the facility. The building was occupied in the fall of 1990.

Population Description: Twenty-one children were enrolled at the Preschool at the time of the site visit. All of the students were between ages three and five at the beginning of the 1990-1991 school year. Most if not all of the children had developmental disabilities. Four children had mild to moderately severe sensory or motor impairments. One child was legally blind (some vision), one had mild to moderate hearing loss, one walked with difficulty, and one had limited use of hands/arms. One child used a wheelchair. Since being enrolled in the Preschool program, the independent ambulation of the child who used a wheelchair had improved to such an extent that after arriving at school he did not use his chair in the building. None of the other current students used any type of aid or device to assist in mobility.

Facilities: The Preschool facility is a free-standing, one-story building. The 4,136 square feet (gross) facility consists of: two preschool classrooms; one resource center ("centrum"); one supplemental instruction classroom (e.g., for speech therapy); one teacher planning area; one student toilet; one student toilet and bathroom; one teacher toilet; one kitchen/laundry area; several instructional, material and student storage areas; and a covered outdoor play area. A variance from State construction standards was required to obtain the covered outdoor area. Enclosed space is provided at the back for a future playground. The building was designed and sited to permit a future addition that would double its size.

The new facility fronts on the entry drive, adjacent to the existing elementary school. It is linked to the elementary school by a covered sidewalk. The front elevation of the new facility is architecturally compatible with the existing facility, further linking the Preschool and the Elementary School.

Data Collection Approach

The general data collection protocol expanded on that established for Task 3. Physical measures were obtained of the accessible features in the building and it was extensively photographed. A small group discussion was held with the Preschool teachers. The students were judged to be too young to participate in a small group discussion. Observations were made of the students arrival and entry into the classroom facility at the beginning of school. Additional observations were completed of students' routine use of the classroom and centrum area. Two students simulated use of the toilet facilities.

The research team was joined during the site visit by the State Department of Education research architect, the University of Florida architectural faculty member who was Principal Investigator of the project to write the standards, the project architect, and County Facilities and Exceptional Special Education (ESE) staff. The participation of this group created a unique opportunity to understand how the standards were implemented in the context of the specific needs of a school district.

Findings

Accessible Route: The 72" *width* of the exterior accessible route (Table 1, Figure 1, Photos 1, 2, 3) exceeds the UFAS minimum by three feet. The route width provides continuous passing space which is important in a facility where several students may be in wheelchairs. There were no vertical changes in level.

During the peak use time of school bus unloading, the *pathway* was able to accommodate a large number of children and adults over a short period of time.

There were no interior corridors in the facility. Rather, classrooms and other spaces were accessed off of a "centrum" space (Figure 2).

Ramps: There were no ramps at the facility.

Stairs: There were no stairs at the facility.

Doors: The main *entry door* was a 4-0 sliding door. A motion-detector was used to open the door from the exterior (Photo 4). The angle of the motion sensor was adjusted to detect small children approaching the door as well as adults. The door opened quickly enough that one did not have to pause for the door to open. Once activated, the door remained open as long as motion was detected. A pressure plate activated the door from the interior (Photo 5). The opening system could be turned on and off manually which permitted staff to control entry/egress at selected times of the day.

Interior and exterior doors had glass panels that were as low as 16" AFF (Table 6, Photo 6). These panels not only permitted children to see out, but also allowed staff to see children who might have gone outside unaccompanied. The panels were low enough that door was not inadvertently pushed open when a child was standing behind it.

Interior doors were habitually left open to encourage children to freely use the building (Photo 7). The force on exterior hinged doors ranged from 5 to 16 pounds force. Level handle hardware was at 34" AFF, 2" below the maximum in the Children's Supplement.

Curb Ramps: There were no curb ramps at the facility.

Signage: There was no signage directed toward the children who were five years of age or younger.

Drop-Off and Loading Zone: The loading zone at the Preschool was constituted by a 240' long, 7' wide covered walkway that paralleled a 24' wide drive with one-way traffic (Table 11, Figure 1, Photos 8 and 9). The loading zone was level with the drive. The minimum distance from the drive to the building was 44'. The extra high walkway cover in front of the building is intended to shelter buses that pull close to the building during inclement weather.

County School Facilities staff reported that the *covered walkway*, especially the elevated portion in front of the building, did not protect children during blowing rain.

Unloading of children attending the Preschool and other grades was observed. The loading zone was able to accommodate a number of buses simultaneously.

Libraries and Media Centers: There was no library or media center at the facility.

Classrooms: Magnetic *blackboards and bulletin boards* used by the children were mounted close to the floor (6") and were no higher than 36" (Table 14, Figure 3, Photos 12 and 13). These objects were placed at this height to be usable by young children whose activities often take place on the floor. Chalk boards and dry erase boards used by the staff were mounted at more conventional heights. Staff reported that the height of the blackboard was good for the children at the school.

The *lighting* system used in the classroom provides fluorescent as well as incandescent lighting (Photo 14). The incandescent system is used primarily at nap times. The classrooms also can be blacked out.

Work surfaces varied in type (built in and tables) and height (Photos 15 and 16). Children appeared to be able to sit to work, with ease. There also were work surfaces that children used in a standing and/or leaning position. The one child who arrived at school in a wheelchair did not use it in the building. Consequently, there was no opportunity to observe how well the work surfaces worked for him.

Teachers reported that the *acoustics* in the building, particularly in the classroom used for speech therapy, were poor. There was no apparent reason(s) for this problem.

Storage: Cubbies had a maximum *shelf height* of 40" (Table 15, Figure 4, Photos 17 and 18). The *clothes hooks* in the cubbies were at 36" AFF which conformed to the Children's Supplement. Staff reported that the cubbie height was "ideal". Two children were observed using these cubbies. One had no problem in reaching the upper parts of the cubbies; the second child had only slight difficulty. In addition to the cubbies, storage for use by children is placed under the sink. Staff reported that, in general, children's storage should be adjustable.

Toilets: All *toilet seats* in children's bathrooms were 12" AFF (15"-17" in Children's Recommendations). This enabled children to keep their feet on the floor for balance and security. The facility architect noted that the determination of toilet height required trade-offs between positioning the seat high enough to be level with a wheelchair seat vs. low enough for small children's feet to reach the floor. Staff commented that it would be advantageous to have some toilets "a little higher" for larger children (Table 16, Figure 4, Photos 16 and 17).

The toilets had a variety of different types of *grab bar* configurations. The "girls" toilet (Photo 20) had a horizontal grab bar on the adjacent wall and a vertical grab bar on the same side. There was an ell-shaped grab bar on the opposite side. Although this grab bar was between the "girls" and "boys" toilets, it was not intended for use with the "boys" toilet.

Staff reported that the distance between grab bars and toilets was too great for ambulatory children who needed to balance while sitting down children. Staff believed that they needed to be as close as 6" to the toilet. As children at this age who are in wheelchairs are typically placed on the toilet, locating grab bars closer to the toilet would not seem to be problematic. Two ambulatory children, one with gait problems, demonstrated sitting down and getting up from the toilet.

One child had some difficulty in reaching and holding onto the grab bar while positioned over the toilet.

Grab bar diameters were small (1.25"). Staff reported that their size worked well for young children.

Staff were pleased that the facility had been equipped with small toilets. They reported that children of this age fall into toilets easily.

Several attempts had been made to find a floor finish that would not be slippery when wet, was not so rough that children who fell would be scratched, and that could be easily cleaned. At the time of the site visit, several floor finishes had been tried. None had proved satisfactory.

Urinals: There were no urinals at the facility.

Lavatories and Sinks: Three styles of lavatories-sinks for use by the children were found in the facility: the inaccessible lavatories, the wheelchair accessible lavatories, and the classroom sinks (Table 17, Figure 4, Photos 21,22, and 23 (lavatories), Photos 24 and 25 (classroom sinks).

The *rim height* of the classroom sink and the inaccessible lavatory was 22". The wheelchair accessible lavatory is 30", which is consistent with the Children's Supplement. *Vertical clearances* were 20"-27", respectively. Staff reported that the 22" sinks were too low for children in wheelchairs, but that the 30" sink was too high for two-thirds of their children. Staff had observed that the wheelchair accessible sink worked best for children with spina bifada.

The bathroom lavatories were residential style oval sinks installed in a boxed in counter. The location of controls on this style sink in conjunction with a desire to place the controls within easy reach for the children, resulted in the sink being installed on the diagonal with a one-piece faucet with integral controls located toward the front and to one side. This placement in conjunction with the use of gooseneck faucets resulted in an awkward arrangement for children to use. They tended to lift their hands up to the end of the faucet and water ran down their arms and onto the floor. The facility architect noted that the placement of the lavatory at an angle created problems with providing the necessary undersink clearances for a wheelchair.

The classroom sinks were rectangular, single-bowl stainless steel kitchen sinks. At the time of the site visit, the one-piece faucet with integral controls was mounted at the front corner. The faucet had been previously located further back on the side. However, this was too difficult for the children to use. With the observed configuration, children were able to square up to the sink and staff reported that this made the sinks less awkward to use than the bathroom lavatories. Although the sinks had open cabinets below, the deep bowl prevented students in wheelchairs from using a front approach to the sink. On the other hand, the placement of the faucet in the front corner made a side approach possible.

Mirrors were placed at 33" AFF at the accessible lavatories, and at 24" at the inaccessible lavatory.

Bathtubs: As many of the children were not potty-trained, children frequently had to be bathed during the course of the school day. One bathtub (Table 17) was provided in the facility. There was a 36" x 75" clear floor space at the tub and grab bars were provided at two heights. The higher grab bar was located on the end wall above the faucet and controls at 28" AFF. The lower bar was located on the side wall at 24" AFF (Figure 4b). However, because preschoolers did not bathe themselves, the clear floor space and grab bars were primarily used by the staff to assist them in bathing the children.

Showers: There were no showers in the facility.

Water Coolers: Water fountains (Table 18) were mounted on the front corner of the classroom sinks (Photos 24 and 25) opposite the faucet. The spout was at 24", 6" lower than the Children's Supplement maximum. Originally the spout was placed on the side behind the faucet, but it was too close to the faucet thus making it difficult for the children to use. Staff maintained that the new location on the front of the sink worked much better.

Controls: An extension of the educational philosophy of the Preschool was that children should learn to both manipulate and be aware of the dangers associated with electrical outlets, switches and other wall mounted controls. Switches were mounted at 38" AFF which is 10" lower than a standard installation and were a rocker-type which are easier to operate than standard toggle switches (Photo 26). Outlets were located at 26" AFF which is higher than a standard installation, although not too high for the children to use. This prevented children from inadvertently injuring themselves while allowing supervised use of the outlets. In contrast, the fire alarm (Photo 27) was deliberately located above a child's reach and had a plastic cover to prevent its use by children.

Public Telephones: There were no public telephones at the facility.

Other Considerations: The rear door of each classroom opened onto a *covered play space* (Photos 28 and 29). The play space was fronted by a fenced in grassy area that is intended to house a future playground for the children. Children were generally free to come and go between the classroom and the covered play space. As discussed above, this play area was obtained only by petitioning for a variance from State construction standards. Staff report that such a space is an important adjunct to the educational and vocational program.

Throughout the interior of the building sharp, squared off corners were avoided in the construction of the building. *Rounded corners* eliminated a safety hazard for children with poor balance.

Conclusions

Accessible Route: During the peak use time of school bus unloading, the width of the *pathway* was able to accommodate a large number of children and adults over a short period of time. The use of continuously wide exterior pathways is advantageous in facilities that are used by large numbers of children at the same time.

Doors: The motion activated sliding door avoided a number of the problems frequently reported with regard to children's use of doors, in particular exterior doors. The problem of push/pull force is eliminated as are problems associated with keeping doors open long enough to pass through. The manual override on the motion activated system provides staff with control over entry/egress which otherwise could not be attained without locking the door.

The lower than typical glass panels in the doors were effective as they not only permitted children to see out, but also staff to see children who might have gone outside unaccompanied. In addition, the panels were low enough that door was not inadvertently pushed open when a child was standing behind it.

Drop-Off and Loading Zone: The length of the passenger loading zone is appropriate and effective for a setting where large numbers of students arrive and depart at the same time each day. The height of the canopy, which was determined by the height of a bus is too high to provide children with adequate protection from the rain.

Classrooms: Wall mounted objects such as chalkboards and bulletin boards that were placed just above the floor worked well for young children whose activities often take place on the floor.

The provision of tables and other work surfaces of different heights provide children and teachers with much needed options.

Storage: Although the top shelf of the children's cubbies was 6" lower than , than the ATBCB's UFAS Supplement for ambulatory children they worked extremely well for these young children. In contrast, the *clothes hooks* in the cubbies, which conformed to the UFAS Supplement, worked well .

Toilets: The 12" AFF toilets enabled the children to keep their feet on the floor, which is important for balance and security during toileting. At least one toilet was needed that was slightly higher for larger children.

Grab bars are needed at toilets. However, the grab bars were too far from the toilet for the children's short arms to reach. Staff recommended grab bars be located 6" from the side of the toilet. Children were able to securely grasp the small diameter grab bars.

Lavatories and Sinks: Sinks of different heights were necessary for this group of children. The wheelchair and nonwheelchair heights accommodated children of different sizes and with different balance and reach capabilities.

The oval bathroom sinks, installed at an angle, did not work well because children were not able to square up to the lavatory. This awkwardness was exacerbated by the front mounted gooseneck faucet. Water ran down the children's arms and splashed on the floor.

In contrast, the classroom sinks worked well and were easy for the children to use independently. Relocating the faucet from the middle of the side to the front corner of the sink likely had a positive impact on children's ability to use the sink easily. The height of these sinks would be too low for children in wheelchairs to use with a frontal approach. However, with the faucets located at the front some children in chairs could likely use the sink by using a side approach.

Drinking Fountains and Water Coolers: The spout was 6" lower than the Children's Supplement maximum and worked well, especially at its front of the sink location.

Controls: While there appears to be a debate about locating controls within young children's reach, this has posed no problems, to-date, at the Preschool.

Covered Play Space The covered play space and its direct access from the classroom enables children to go outside and play in inclement weather.

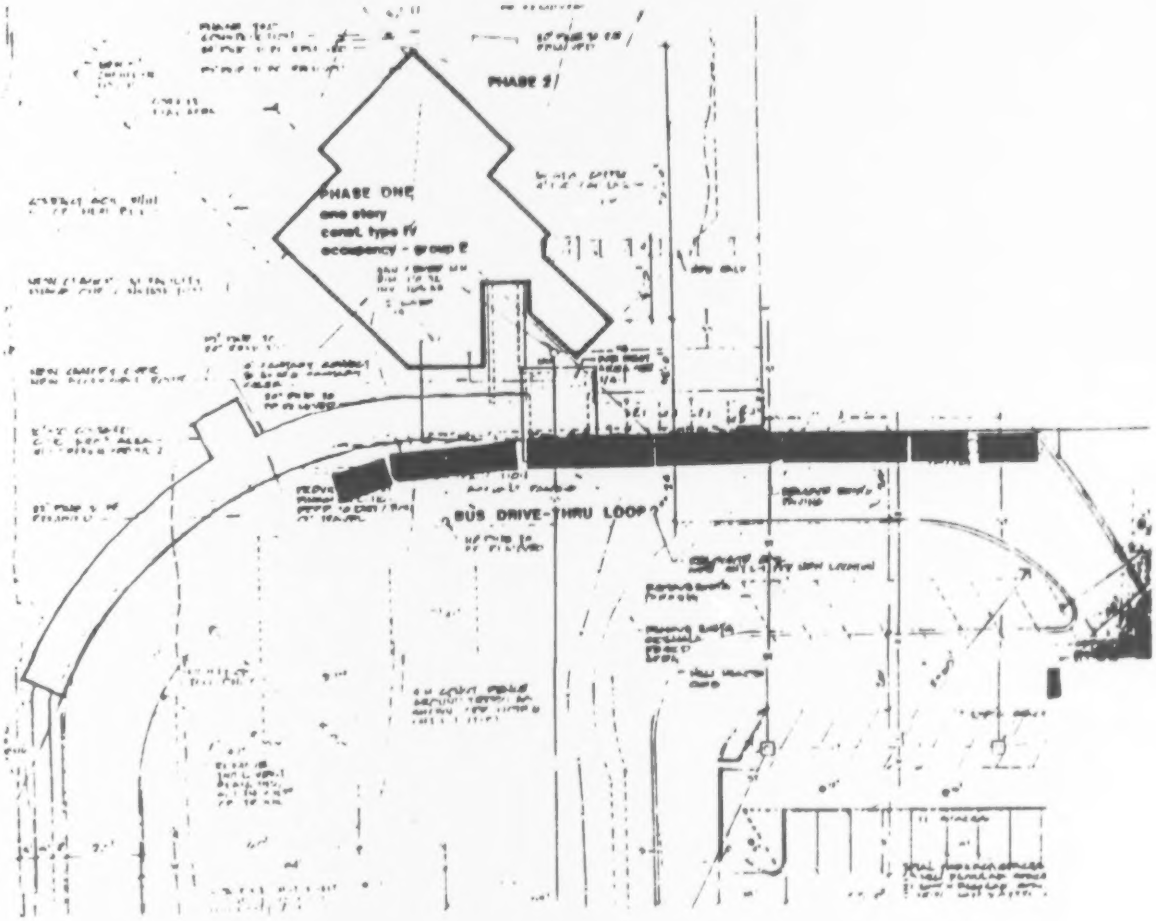
PHASE 2
PHASE ONE
one story
const. type IV
occupancy - group E
BUS DRIVE-THRU LOOP

Figure 1. Site Plan

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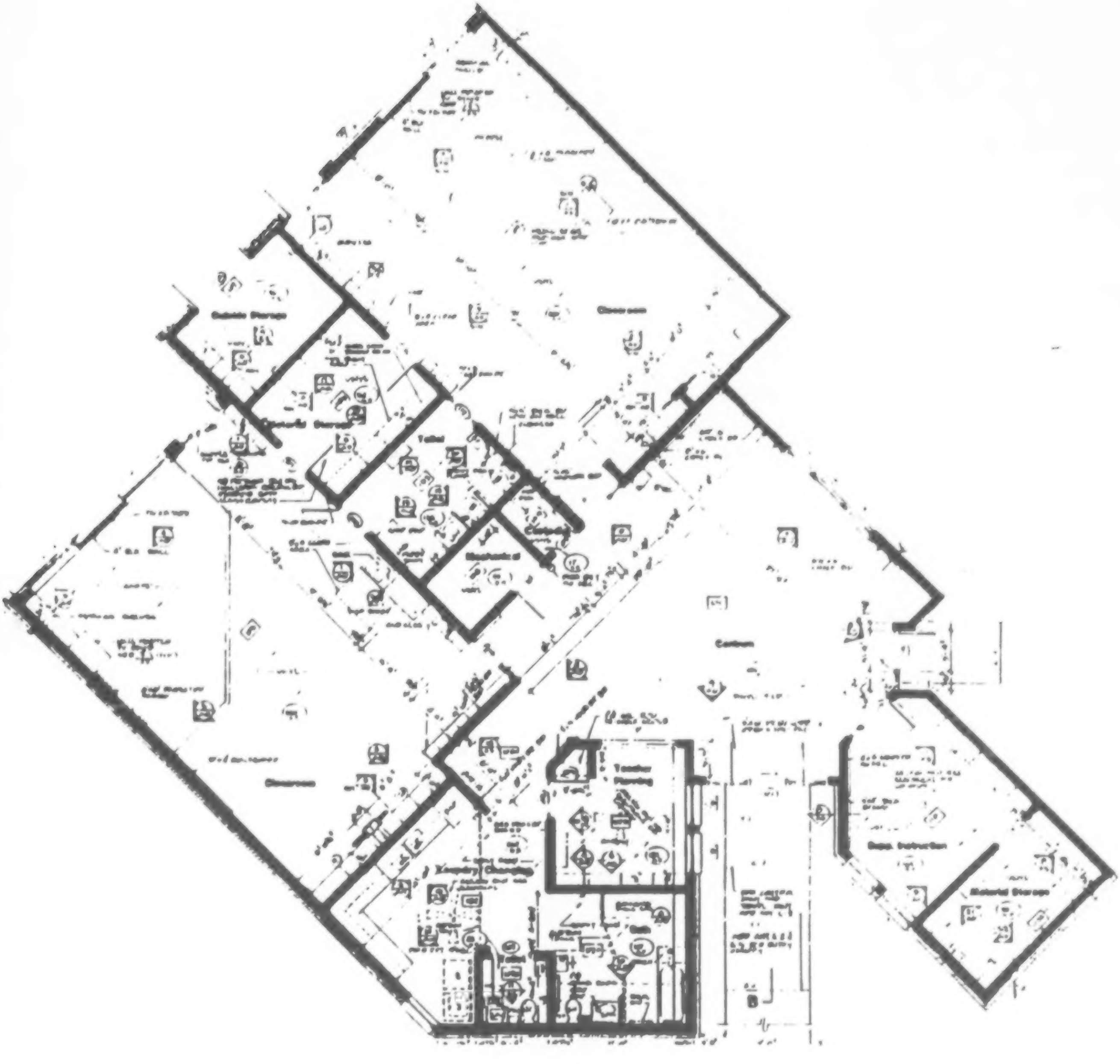
Outside Storage
Classroom
Toilet
Mechanical
Classroom
Teacher Planning
Group Instruction
Material Storage

Figure 2. Floor Plan

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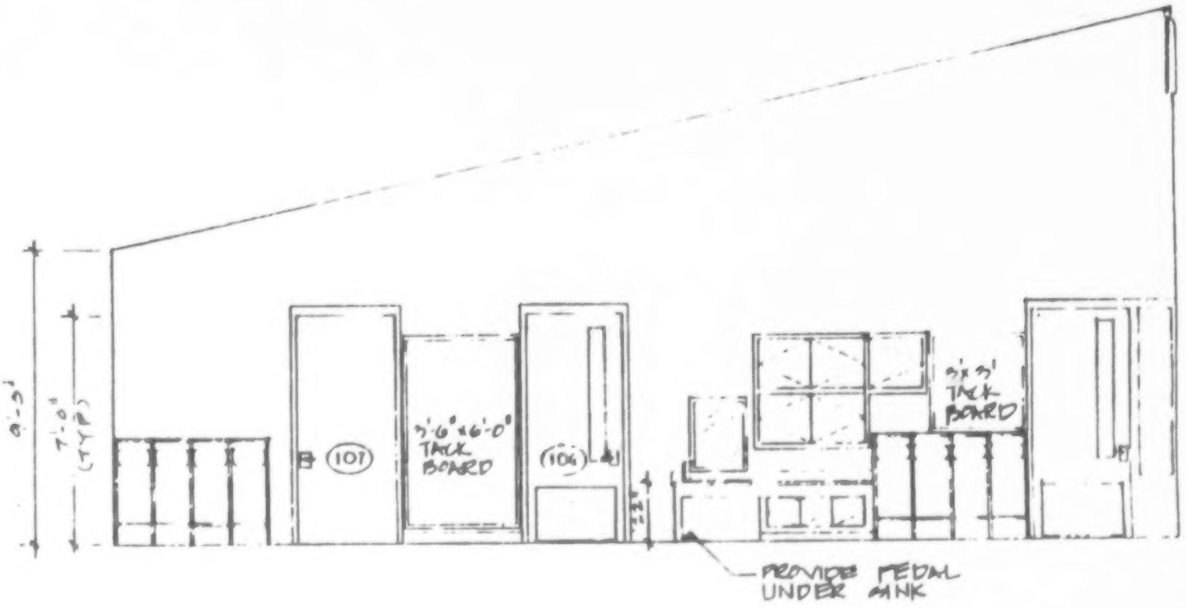
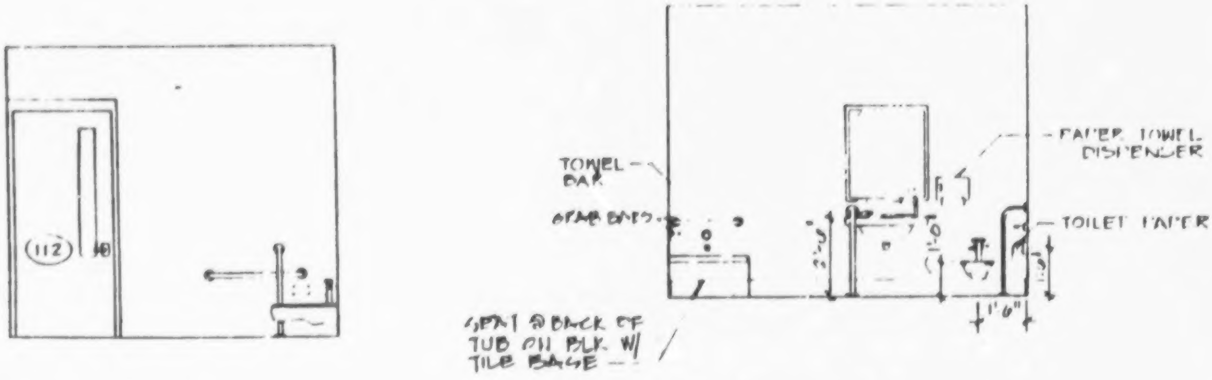
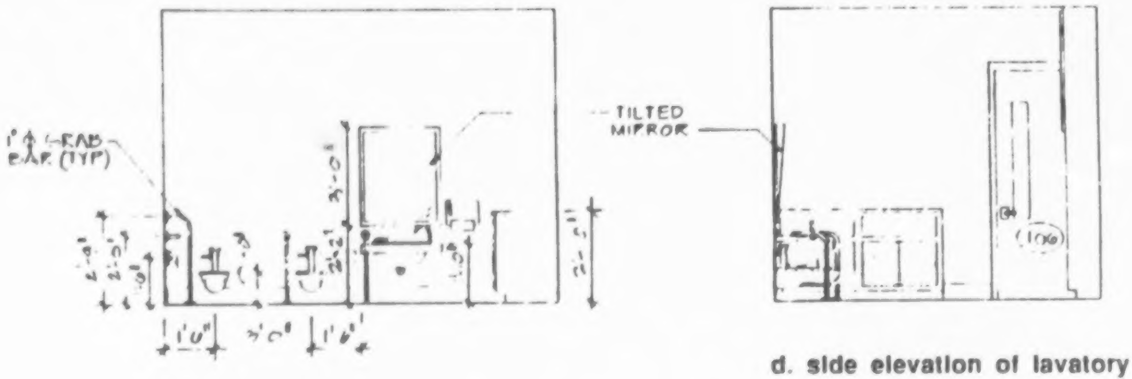

9'-3'
7'-0"
(TYP)
107
3'-6" x 6'-0"
TACK
BOARD
106
3' x 3'
TACK
BOARD
PROVIDE PEDAL
UNDER SINK

Figure 3. Elevation of classroom sink and storage


112
TOWEL BAR
GRAB BARS
3'-0"
1'-0"
PAPER TOWEL DISPENSER
TOILET PAPER
1'-6"
SEAT @ BACK OF TUB ON BLK. W/ TILE BASE

a. side elevation of toilet/grab bars in classroom bath

b. wheelchair accessible sink


1" Φ GRAB BAR (TYP)
3'-0"
1'-0"
3'-0"
1'-6"
TILTED MIRROR
106

c. front elevation of classroom bath

d. side elevation of lavatory in classroom bath

Figure 4. Toilet room configurations

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GEORGIA ACADEMY FOR THE BLIND
MACON, GEORGIA

Site Description

The Georgia Academy for the Blind, founded in the late nineteenth century, is located in Macon, Georgia, a ninety minute drive south of Atlanta in the central part of the state. The Academy serves both residential and day students who are visually; visually and orthopedically; and visually, orthopedically and developmentally disabled. Unlike similar programs in some other states, the Academy does not close every Friday. Thus, for much of year the school is the weekend as well as weekday home for its residential students.

Although the Academy's students come from throughout the state of Georgia, many of the students come from rural areas and small towns where local school systems are unable to meet their educational needs. There are few students from the metropolitan Atlanta area.

Population Description: The Academy served a total of 164 children and young adults at the time of the site visit. Two-thirds (n=110) of these were residential students, and 47 percent (n=77) were age 14 or younger. In the current population of students aged 14 years and younger, six children were less than five years old, seventeen were ages five to eight, 28 were ages nine to eleven, and 26 were ages twelve to fourteen.

Of the age 14 and younger population, 41 students were legally blind (some usable vision) and 36 were totally blind (no usable vision). Other physical disabilities present in this group included: "unable to walk" (n=3); "walks with difficulty" (n=6); and "limited use or hands, arms" (n=1). A number of students also had developmental, emotional and related disabilities in addition to visual disabilities. Most of this group of students were observed to have orthopaedic involvement as well. This diversity in type and severity of disabilities is a fairly recent phenomena among the Academy's student population. It is expected that in the future increasingly larger proportions of the student population will be multiply disabled and more severely disabled.

The age 14 and younger population used a variety of aids and devices as they moved about the site and in buildings. These included: long canes, manual wheelchairs, crutches, and walkers. Many singly impaired children (i.e., visually impaired only) did not use any aid or device to move about the site and within buildings after they become familiar with the layout of the site as a whole and its buildings.

Facilities: There are 22 structures on the Academy's site (Photo 1) including: eight cottages; one classroom building; one gymnasium; one administration/auditorium/music building; one vocational instruction/caning shop; one horticulture classroom/greenhouse; one kitchen/dining room; one infirmary; and a variety of storage, mechanical and staff residential facilities. All of the current buildings have been built since 1958. The facilities used most frequently by students were completed and occupied primarily between 1958 (gymnasium) and 1981 (classroom building), with most of this construction completed between 1968 and 1973. Three cottages were occupied in 1968. The other five cottages, and the kitchen/dining room were occupied in 1973. In other words, the design and construction of the residential, classroom, and recreational facilities used by the students predate the State of Georgia's adoption of the ANSI standards in 1984.

Most of the accessible features found on the site were retrofitted in order to achieve accessibility for students with orthopaedic problems. These include toilet and shower renovations, and the addition of interior and exterior ramps in the cottages and classroom facility. There are virtually no identical toilet modifications in the cottages as they have been developed on a case-by-case basis for a specific child who it is presumed will reside in a cottage for a number of years.

There are surprisingly few modifications to the buildings or the site to ameliorate the low vision/blindness common to all students, and many of these appear to be directed to personal safety. For example, exterior culverts were covered in wire mesh, and stair risers were painted bright yellow. The Director of the Academy explained that there was little need for orientation and wayfinding cues to aid the students as they became familiar with the site through repeated use.

Data Collection Approach

Facilities Evaluated: The evaluation at the Georgia Academy concentrated on the cottages that house the residential students. Limited information was obtained on accessible features in the Classroom Building. This emphasis was dictated by both the location of accessible features on site as well as the availability of adults and students to participate in the data collection. Most of the accessible features on site were located in the cottages. Additionally, the Director requested that the involvement of students in the data collection be limited to after school hours, a time when house parents were on site, but teachers and educational staff were leaving for the day.

The cottages at the Georgia Academy are located in two areas on the site. Cottages 1 - 4 are designated for "Multihandicapped" students, which includes only those students with developmental, emotional or related disabilities in addition to vision disabilities. Many of these students also have ambulatory problems and use wheelchairs or walkers. The other group of four cottages (Cottages 5 - 8) house students with vision, as well as vision and orthopaedic disabilities. The latter group of students are not referred to as "multihandicapped" at the Academy. Within each group of cottages, the residents of each cottage are of similar age. Girls and boys of similar age are housed in the same cottage, but are assigned to different wings, ends of the halls, etc.

In Cottages 1 - 4, those used by the multihandicapped students, the bathroom areas are located between two large bedrooms for four or more students. Each bathroom contains three toilets. The toilets varied in seat height and associated grab bar configurations. All of the bathrooms contained a large, roll-in shower. Several of the bathrooms have had bathtubs added. A beveled edge had been added to some showers to make it easier for a child in a wheelchair or an attendant to get a wheelchair in and out of the shower. Each cottage contained two of these double bedroom/shared bathroom layouts.

The interiors of Cottages 5-8 are reminiscent of college dormitories -- double loaded corridors with two-person rooms. In most cases, a congregate bathroom is located on each end of the hall. In the new wing of Cottage 7, bathrooms are located between each pair of two-person rooms. Cottages 5-8 are located on a hilly part of the site and were designed as split level facilities with the main entry at grade and bedroom areas located on the upper level and accessed by ramps. The new wing of Cottage 7 is on the same level as the main entry to the building.

Data Collection: The data collection followed the general protocol established for Task 3. Physical measurements were obtained from representative cottages from both groups (i.e., Cottages 1 - 4 and Cottages 5 - 8). Separate small group discussions were held with the house parents from both groups of cottages to obtain their perspectives on the suitability of the accessible features in the cottages for the current residents.

The original plan was to observe multihandicapped residents of Cottage 4 who used wheelchairs simulate transfer and toileting. However, informal observation of these students suggested that they would not able to follow instructions regarding the completion of the simulations. The decision was made to substitute a discussion with an attendant who assisted students in toileting rather than attempt to complete the simulations. Consequently, no observational data were obtained on the accessible features in these cottages.

Observations of simulated use were conducted in Cottages 5-8. These simulations focused on the shower and bathing areas. The children identified to participate in these simulations were only vision impaired.

Physical measures and limited observation of naturally-occurring use of accessible features were completed in the classroom facility. In addition, discussions were held with staff knowledgeable about the rationale for some of the design features of the classroom facility.

Findings

Accessible Route: According to the Director, all exterior walkways had been graded to a slope of 1:12 in order to make them more accessible for the students. This was not the case with the vehicular roadways that often served as pathways for children as well. None of the pathways had tactile warnings or signage to aid in safe orientation and wayfinding. Younger students and multi-handicapped students in wheelchairs were never observed moving about the site or within buildings without being accompanied by staff.

Several of the core, non-residential buildings (e.g., Classroom Building and Dining Hall) were connected by covered walkways. Although some staff and children preferred to have all of the facilities connected, the school's policy was that students should encounter real-world situations. Because their homes were not connected to public facilities by covered walks, then neither should their dormitories. Cost was also a factor.

The entry ramp to the Classroom Building is located at the rear of the facility and is the most convenient entry from Cottages 5-8. The Classroom Building is joined by an internal hallway to the Administrative/Music Building, making that building accessible, although by a rather circuitous route.

Ramps: Ramps in the Classroom Building, and Cottages 5 and 7 were evaluated. All three appear to have been installed over the full width of preexisting stairs. The ramp *slopes* ranged from 1:10 - 1:12 (see Table 2). The ramps ranged in *width* from 48" to 120". The ramps with open sides did not have *edge protection*. *Handrails* that appeared to be stair railings were installed at locations where ramps were not enclosed by full walls. None of the railings extended beyond the end of the ramp.

The Classroom Building ramp had the shallowest *slope* (1:12) of the three ramps (Photo 2). A secondary doorway to a classroom is located part-way along one side of the Classroom Building ramp. There is a small level area in front of the door. No *railings*, *tactile warnings* or other cues easily discernable by sighted and unsighted users are used to mark the level area. The ramp is entirely enclosed by walls. There are no *handrails* along the ramp, *handrail extensions*, or *tactile cues* at the top of the ramp that it is being approached.

Observations of naturally occurring use of the Classroom Building ramp was conducted during a class change period. The students (n=7) observed using the ramp appeared to be of middle school age or older. No students with orthopaedic impairments used the ramp during the observation period. All those observed used the ramp unaccompanied. (In contrast, younger children appeared to seldom move around the building unaccompanied by an adult.)

One student appeared to experience slight difficulty with the slope. The slope was not observed to create problems for the others. The full width of the ramp was not used. Most observed users walked on the opposite side of ramp from the landing at the classroom door, suggesting that due to familiarity with the ramp they knew the landing was there and avoided it. Nonetheless, the landing would seem to pose a safety hazard for new students and sighted as well as visually impaired visitors not familiar with the ramp. The absence of cues on approaching the top of the ramp did not appear to create any hesitation or uncertainty during the observation period, again perhaps due to the users' familiarity with the building and ramp. No missteps at the top or bottom of the ramp were observed.

Cottages 5 and 7 (Photos 3 and 4) had at least one residential floor above grade, with kitchen, living room space, and TV area at grade. The residential floors were accessed by a ramp(*width* [48" and 50"] and *slope* [1:10]). The ramps were only partially enclosed. Decorative grill work (73.5" AFF) had been installed on the open side of the ramp in Cottage 5 to prevent children from accidentally falling off the ramp to a lower, unused level of the Cottage. House parents indicated a preference for all spaces on one level because of misbehavior on the ramps.

Stairs: The risers on exterior stairs were painted bright yellow in order to serve as a visual warning. Inspection and use of these stairs gave no indication that painting risers worked for this purpose. However, this device might be helpful to individuals with low vision in locating exterior stairs from a distance (Photo 5). There was no tactile cues or other treatment on the front of treads to help delineate the edge.

Risers on exterior stairs were 5.5", *treads* were 11.5". A typical set of exterior stairs used as a secondary exit from a cottage had 16 steps (Table 4).

Doors: The clear opening width of all *exterior doors* was 36". A few of the doorways had thresholds, and those that did, were within the UFAS limits of 3/4". Door hardware consisted of push/pull handles at 38" to 40" AFF, which exceeds the Children's Supplement of 36" maximum. Ten to fifteen pounds of force was required to operate the exterior doors. Several children reported that they could not open the rear exit door to Cottage 5 because it (15 lbf) was too heavy.

The *interior doors* to the congregate bathrooms in Cottages 5 and 7, and the between room bathrooms in Cottage 4 (Photo 9), a cottage for multihandicapped students, opened into the bathrooms (Table 6, Figure. 1b-d). In Cottages 4 and 5, when the door was left open, it blocked one toilet (Photo 10). However, children expected the doors to be open. When the doors were closed, the children bumped into them, sometimes injuring themselves. Doors that swung out into hallways or bedrooms also posed potential safety problems for visually impaired children. One house parent suggested that the bathroom doors be eliminated for safety reasons.

Rooms on one wing of Cottage 5 had a shared bathroom between two, two-person rooms. The bathroom *door width* was 28 7/8", and swung into the bedroom. The location of built-in desks and clothes storage in these rooms dictated the location of beds; when the bathroom door was open 90 degrees, there was only 12.5" *clearance* between the door and the end of the bed. When the door was fully open, it interfered with the opening of the bedroom to hallway door.

The *threshold* between the hallway and bathroom in Cottage 5 was 1.5" and had been beveled.

The entry *route* into the bathrooms in the Classroom Building was L-shaped -- sight lines from the hallway of the toilet area were blocked by an interior wall. These doorways had been removed, presumably to either eliminate a safety hazard as the door was pushed open or to widen the opening to create a more wheelchair accessible route into the bathrooms.

Curb Ramps: There was one curb ramp on the site. It was located in the staff/visitor parking lot at the handicapped parking space. No visual or tactile *warnings* marked the ramp (Table 7).

Signage: Signage in the Classroom Building consisted of a typical manufactured sign with *braille* added on with embossed tape (Photo 6). The embossed tape was observed to have curled up and/or fallen off of many signs. However, this was not reported to create problems, perhaps due to the students familiarity with their environment. The braille was mounted two to four inches below standard information. Signs were mounted at heights ranging from 59" to 66" AFF. This is close to adult eye level and much higher than the Children's Supplement recommendation (40" max.) (see Table 9).

Libraries and Media Centers: The library in the Classroom Building was furnished with stacks typical of college libraries. The top shelves were not used. The top of the card catalogue required a reach of 40", which is higher than the Children's Supplement recommendation of a maximum of 36". However, there were no reports of problems with this height. Child size as well as full scale reading tables and chairs were provided. Light levels in the library ranged from 36 to 51 foot candles. All the lighting in the library was from artificial sources. There were no observed problems with glare on horizontal surfaces such as table tops (see Table 13).

Classrooms: The height and type of work surfaces varied among the rooms, depending on the type of activity and class (e.g., typing, industrial arts) and the age of the student using the room. Work surfaces were of a consistent height within each room. All of the classrooms were illuminated by artificial light. None of the classrooms had windows. At least two light levels were available in most of the classrooms (see Table 14). Each room was divided into a number of lighting zones so that different students could have levels of illumination that met their needs.

Storage: Built-in clothes cupboards, built in desks, clothes hooks, and towel shelving were documented in cottage bedrooms and bathrooms. Adjustable shelving was provided behind the beds above a drawer unit (Photo 7). However, the depth of the drawer unit made all but the lowest shelves unusable by children. Shelving in the congregate bathroom in Cottage 7, used for towels, hairbrushes, etc. (Photo 8), ranged from less than three to five feet in height. Visual inspection revealed that it was almost unused. Three elementary school age children simulated use of this shelving. The results were widely varied. One was unable to use it, one could use it only with great difficulty, and the third child experienced little difficulty. None of these children used wheelchairs. The observed problems in using the shelving were, nonetheless, related to the height of the shelving (see Table 15).

Toilets: Physical measures obtained for toilet seat height, stalls, grab bars and clear space outside of toilets varied widely (Table 16).

In the congregate bathrooms in Cottages 5 and 7, *toilet seat heights* were typically 15.5" AFF, which is within the range specified by the Children's Supplement of 15" - 17" AFF. One toilet had been modified to 19.5" AFF, which exceed the UFAS range (17" - 19" AFF), to meet the needs of a specific student. Flush *controls* on the institutional style toilets ranged from 32" to 37" AFF (Photo 11). *Stalls* ranged between 31.25" and 33.25 in width, and 56.25"and 63.5" in length. The 19.5" AFF toilet was in the deeper stall and the door had been removed. *Toe clearance* in this stall was 12.25". It also included *grab bars* (37" AFF) that effectively reduced the stall width to 27" *Grab bars* were not installed in the other stalls. No students who use wheelchairs currently live on the hallways assigned to these bathrooms.

The shared bathrooms (between bedrooms) in Cottage 7 were small, approximately 4-0 x 5-0, not including the shower, which left little *clear floor space* to maneuver a walker or similar device. Toilets were installed in one corner of the bathroom, at an angle (Photo 12) to allow walking clearance in front of the door. The sink counter was extended along the wall and required that the toilet be pulled out from the wall almost 1-0. Toilet seat *height* was 15 5/8". No *grab bars* were provided.

In Cottage 4 (Photos 13-15) *toilet seat height* ranged from 14.5" to 19" AFF. None of these toilets were enclosed by stalls. Each had a different grab bar configuration. The two lower toilets were located in recesses in corners (behind the entry door when it was opened) with 25" *grab bars* installed at an angle (36" AFF at the front tapering to 26" at the back). The 19" AFF toilet utilized a straddle bar configuration that was 31" high and extended 24 " from the wall. A 16" AFF toilet used conventional grab bars at 32" AFF.

Cottage 4 was not originally designed to accommodate students in wheelchairs, even though most of the current residents are in chairs. The various toilet/grab bar configurations observed were designed by the physical therapist at the Academy and were intended to respond to the needs and capabilities of specific students who have occupied the Cottage at different times. House parents did not report any problems related to the toilets that were related to their accessibility. House parents' and an attendant's major concern was that there were not enough toilets in each bathroom for the number of multihandicapped students.

The accessible toilet in the Classroom Building (Photo 16) had a *seat height* of 19" AFF and was located in a 35.75" by 78" stall. *Grab bars* were at 33.5 AFF.

Urinals: The boys bathroom in Cottage 5 contained two urinals (Photo 17), one at 17.5" and the second at 23.25" AFF (Table 16). Controls were 38.5" and 45" AFF, respectively. Both were fronted by a 67" by 71" area of clear floor space.

Lavatories: Lavatories varied widely on all critical dimensions (Table 17).

In Cottage 5 (Photo 18), there were two styles of lavatories, recessed in a counter top and wall-hung. Their *heights* were 32.5" and 37.5" AFF at the rim, respectively. Although the latter appears to have been intended to be wheelchair accessible (e.g., it had lever handle *controls* at 14.5" from the front of the sink and 29" *vertical clearance*), the *rim height* exceeded the UFAS maximum of 34". The second style of lavatory, a recessed bowl with a surrounding counter, had knob handles that were 21" from the front of the counter. The bottom of the mirror over both styles of lavatory was 48" AFF, which is higher than the UFAS allowance of 40".

Lavatories in the congregate bathrooms in Cottage 7 were wall hung. The *height* of the lavatory rim was 28.25" AFF with 25" *vertical clearance* at the front apron. Available *knee space* was 20.25" high and 10.25" deep (to drain), which do not meet the Children's Supplement requirements (24"high min.; 17" deep min.). *Toe space* was 8.75" high by 6" deep. The mirror was 43.5" AFF. Two visually impaired students, approximately nine years old, simulated use of this lavatory. They experienced no difficulty with the height of the sink or of the mirror.

The shared bathrooms (between bedrooms) in Cottage 7 had pedestal lavatories whose *rim height* was 30.75" AFF, 2.5" higher than the rim heights of lavatories in the congregate bathrooms in the same cottage. *Vertical clearance* was 27.25" AFF at the apron and 23.75" at the bottom of the bowl. *Knee space width* was defined by a side wall and the toilet (25.5"), although one would have to straddle the lavatory pedestal to sit close to the front rim. The *mirror* was 32.75 AFF.

The bathrooms in the Multihandicapped Cottages had two identical wall hung sinks. They were 31.5" *height* at the rim with a 30" *vertical clearance* from the bottom of the apron. *Knee space* was 25" high by 26" deep. Available *toe space* was 10". The *mirrors* above the lavatories were 36.5" The students who live in these cottages are of different ages and body sizes, and many are nonambulatory.

Bathtubs: Bathtubs were installed in the girls congregate bathroom in Cottage 7 and the bathrooms in Cottage 4.

The bathtub in Cottage 7 (Photo 21, Figure 1a) had been installed in a preexisting shower. The original controls and shower head were retained. The tub was installed on a platform that raised the *rim height* to 32" AFF. A very narrow (12") set of unenclosed narrow steps paralleled the tub. The tub also had a hand held *shower* and *grab bars*.

Staff reported that the tub was at this height to prevent a houseparent from having to bend over while assisting young and/or severely disabled children with bathing. However, none of the current residents of the Cottage required such assistance.

Two surefooted residents demonstrated use of the tub and shower. Neither experienced any problems in entering the tub. One had some difficulty in locating and using the grab bar.

In Cottage 4 a bathtub (Photo 22) was installed at conventional height in a corner of one of the bathrooms. The *clear floor space* beside the tub was 97" wide by 126" long. A *grab bar* was installed at 35"AFF.

Showers: Most bathrooms had shower stalls or congregate shower facilities (Table 17)

The *shower stalls* in the congregate bathrooms in Cottage 5 (Photo 23).were 41" wide by 36" deep, slightly wider than the 36 inch by 36 inch stall required by UFAS. *Controls* were 50" AFF (UFAS, 48" AFF max.). Folding seats but no grab *bars* were installed in the showers. The floors of the shower were level with the bathroom floor and sloped to the control wall end of the stalls where the floor was dropped 1.75" to create a 8" wide drainage trough. Five students demonstrated use of the showers. None of the children used wheelchairs or had ambulatory problems. One child had some difficulty locating the shower controls. The drainage trough created problems for two of the children.

Cottage 5 (Figure 24) had a gang shower (72" by 57") with three sets of *controls* (51" AFF) and stationary shower heads. *Grab bars* were installed on the three enclosed sides at 41" AFF, which exceeds the UFAS maximum by 5". House parents noted that more grab bars and lower grab bars are needed. There was no curb. Houseparents noted that hand held showers would help them from getting wet when they need to assist a child in showering.

The bathrooms between bedrooms in Cottage 7 (Photo 25) had large (46.5" wide by 36.75" deep) *shower stalls. Controls* were 46.75 AFF. There was a fold up *seat* in one shower stall, and *grab bars* had been installed at 36" AFF. The shower floor was 1.75" below the bathroom floor. The *curb* was not beveled. The house parent for this wing of Cottage 7 expressed concern over the safety of the shower for a current resident with ambulatory and balance problems.

The shower in Cottage 4 (Photos 26 and 27) was 46" deep by 72" wide. Although the shower met UFAS requirements and was used for roll-in showering, the shower *curb* was 2.5". The shower was open on two ends. One entry had been modified with a beveled curb. House parents reported that the bevel makes it easier to roll students into the shower who require assisted showering. *Controls* were 46" AFF, ten inches higher than the Children's Supplement maximum . House parents reported that the controls needed to be higher so that children could not reach them,, thereby preventing accidental scaldings. *Grab bars* were installed but house parents reported that more grab bars were desirable both to help students orient themselves in the shower and to increase a sense of security for students with poor balance.

Drinking Fountains and Water Coolers: Several types of drinking fountains were installed in the different cottages and the Classroom Building (Table 18). The *spout height* ranged from 34.5" AFF to 43.25" AFF, none of which met the Children's Supplement requirement of 30" maximum. Several water coolers were older wall hung models with no *knee space* available. *Toe spaces* ranged from 9.5" to 10" deep. One water cooler (spout height of 39.25" AFF) had *knee space* of 27.75" high, 18.25 deep and 17.25 wide. House parents believed that children in wheelchairs would not be able to use many of the water fountains.

Public Telephones: A pay telephone was located in the entry lobby of Cottage 7 (table 21). A large table blocked easy access to the telephone by ambulatory students. The coin slot (highest operable part) was 56.5" AFF. The cord was 32.5" long.

Conclusions:

A number of the features that might be expected to be accessible for visually impaired students, such as the walkways, curb ramps, and signage, were not found to have been modified. The lack of modifications in these areas appear to have been impacted by the teaching staff's beliefs that the students' familiarity with the Academy's environment negated a need for such changes; and that a part of the educational process included learning how to function in "real world" situations. Accessibility on the site was directed toward those students with orthopaedic impairments. Not unexpectedly, teaching and residential staff comments and concerns also were directed toward this group of students. Because few of these students were reported to be capable of independent functioning, accessible modifications appear to have benefitted the caregivers more directly than the students.

Ramps: Although the slopes of the ramps in the Cottages are steep, they do not present a problem for most of the current residents who do not have orthopaedic impairments. If and when more children with orthopaedic impairments become part of the Academy's population, the slope of these ramps will likely be problematic. Unfortunately, installation of shallower ramps in pre-existing spaces in the cottages will be difficult because of the configuration of the buildings.

Stairs: The absence of tactile warnings on the front of treads to help delineate the edge is problematic for children who are visually impaired. Moreover, there is no indication that the painted risers found on this site worked for this purpose.

Doors: Hinged doors that swing into the path of travel create a safety hazard for visually impaired children. Conversely, hinged doors that swing into rooms can potentially block functional areas. Children at the Academy have come to expect doors in shared spaces in the residential buildings (e.g., bathrooms) to be open. When they are closed, this poses a safety hazard. The one exception was in the bathrooms in the Classroom Building where bathroom layout permitted the doors to be removed while still maintaining privacy.

Children also had difficulty opening exterior doors that required a great deal of force. This not only caused a problem with general access, but was a potential threat to the children's safety in a fire or other emergency situation.

Libraries and Media Centers: The library in the Classroom Building appeared to work well. The lighting system provided adequate illumination for most activities. The variety of table heights accommodated users of different ages and body stature.

Classrooms: The multi-level lighting system and windowless classrooms seemed to respond well to the often contradictory lighting needs of visually impaired individuals. High or low lighting levels could be created simultaneously in different areas of the room and glare from natural sources was avoided.

Storage: Storage in general was too high to be used by children who were ambulatory or by those who used wheelchairs.

Toilets: A number of different types of toilets and styles of grab bars were found in the cottages occupied by the multihandicapped students. These installations were custom designed by the Academy's physical therapist to meet the range of needs of the students. Some of the toilet configurations complied with the current requirements, however others, such as one that included a "straddle grab bar", did not. Unfortunately, students who occupied these cottages were unable to participate in demonstrating the use of these features.

A child in a wheelchair would likely experience difficulty in using the toilets in the congregate bathrooms in Cottages 5 and 7 independently. The toilet location in the shared bathrooms between bedrooms in Cottage 7 is poorly conceived.

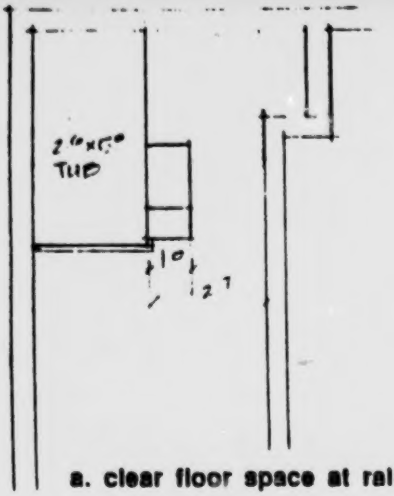
Lavatories: Despite the wide variation and deviation from standards/ recommendations in the critical dimensions related to lavatories, no problems were observed or reported related to lavatories in Cottages 5 and 7.

Bathtubs: The raised bathtub which enabled a houseparent to assist young and/or severely disabled children with bathing.without having to bend over was located in Cottage 7 where there were no children who required assistance. In contrast, a standard tub was located in Cottage 4 where none of the children were able to bathe independently and all required assistance.

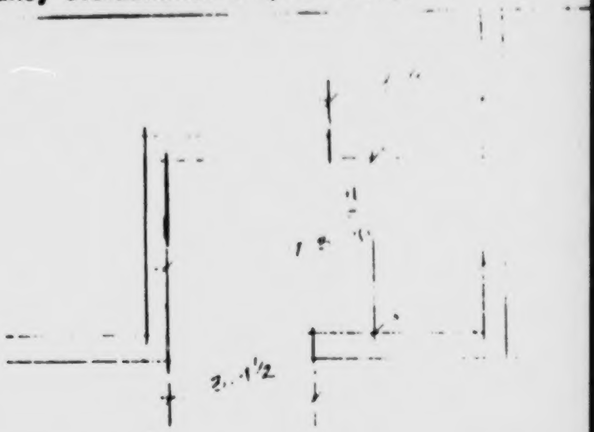
Showers: Although shower floors were found that were more than 1/2" lower than the floor of the bathroom, few of the drop-offs that resulted were bevelled to permit easy access by wheelchairs. In Cottage 4 bevels were present, but they were very steep. This caused difficulty for the caregivers who had to roll the children in and out of the showers.

Grab bars found in the roll-in or congregate showers were either at the UFAS maximum height or higher. More grab bars and lower grab bars are needed in the roll-in showers to increase the security of students with balance problems.

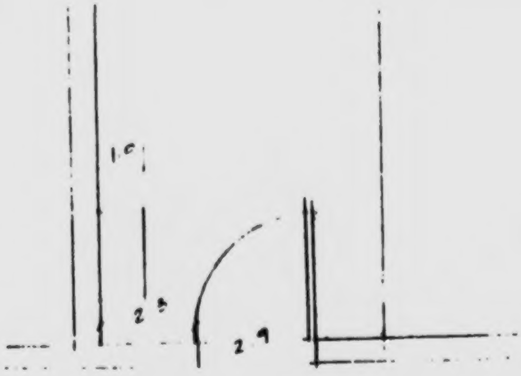
Finally, a hand held shower would facilitate the bathing of the multihandicapped students who require assisted bathing. This would enable staff to wash the student without getting wet.


2'6"x5'0"
TUB
1'0"
2'7"

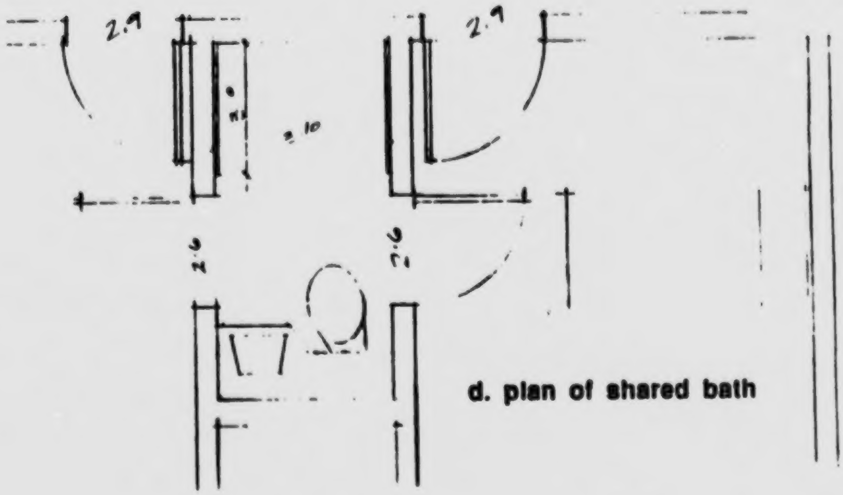
a. clear floor space at raised tub



b. entry to bathroom in Classroom building



c. entry to congregate bath


2'9"
2'9"
2'10"
2'6"
2'6"

d. plan of shared bath

Figure 1. Toilet room details

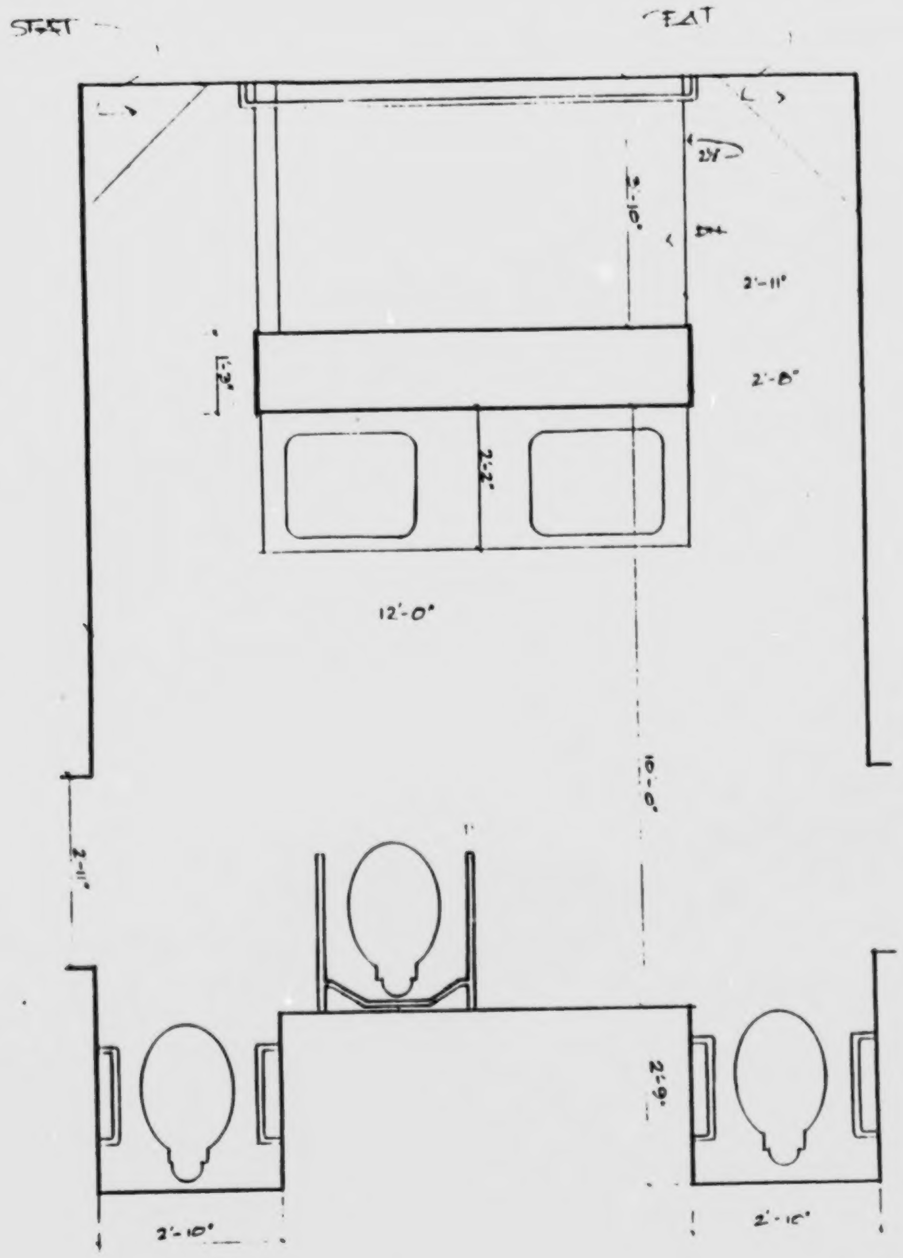

START
SEAT
2'-10"
2'-11"
1'-2"
2'-8"
2'-2"
12'-0"
10'-0"
2'-11"
2'-9"
2'-10"
2'-10"

Figure 2. Congregate bathroom, multi-handicapped cottage

MASSACHUSETTS HOSPITAL SCHOOL
BAYLIE'S BEGINNING CENTER
CANTON, MASSACHUSETTS

The Massachusetts Hospital School and Baylie's Beginning Center are located on a 160 acre, campus type setting in Canton, a town fifteen miles southwest of Boston. These two publicly supported sites are programs of the Massachusetts Department of Public Health. Although located on the same campus, they are organizationally separate and serve different populations.

The Massachusetts Hospital School

The Massachusetts Hospital School was established as a residential facility by the state legislature in 1907 as part of the movement to shelter people with physical disabilities from "unhealthy urban environments" and to provide them with "sun and grass". It was the first facility of its kind to combine medical services with educational instruction. In the early days, when local communities had few options for children with disabilities, children with minor physical limitations,"a limp", were sent to the school which was then called the "School for Crippled Children", to "make shoes". Its population has changed dramatically in the last ten years as educational philosophy, expectations and legislation have changed. More local communities have established public school programs for children with disabilities. Now, many children come to the Mass Hospital School after attending public school, "to gain independent living skills". The criteria for admission states a "physical condition which requires medical management" and admission is time limited; students leave when they turn 22, the cut-off age for educational entitlement.

Population Description: The overall student population at MHS is now older, ranging in age from 9 to 22, with the average age 18. All have severe mobility limitations requiring arm crutches or manual and power wheelchairs. Only seventeen are under 14. For this study, we focused on a group of these younger children. Sixty-two MHS students are between 14 and 18, and forty four are between 18 and 22. Half of the 132 students have some mental as well as physical disabilities. About 20% of the students are day students and the rest are residential. About 25 children are without active families and live full time at the school. One hundred seventeen children are unable to walk and fifteen walk with difficulty. Sixty five have limited use of their arms and hands and ten are unable to use their arms and hands.

The seven children who participated in this study ranged in age from 9 to 13 and did not appear to have any cognitive limitations. All used wheelchairs of varying sizes, five using power chairs, one of which was a scooter, and two using manual chairs. The children using manual chairs had good upper body strength and control. The children using power chairs had limited arm strength, control and reach. All of the children were articulate. One child had limited speech but he could communicate with the children and staff.

Facilities: The campus has several dozen buildings, including a nationally acclaimed recreation center, a large "newer" (1960) brick school building, older dormitory "cottages" as well as barns and other vestiges of a remote self contained residential village. All of the major buildings are connected by covered pergolas which creates a system of accessible walkways and bridges on the campus which has some major level changes. (These walkways have been under major repair for the past month; most of them are usable but none of them had any of the handrails in place at the time of our visits). In addition, accessible vans are a key element here. The administrator who facilitated our visits noted that more money was now spent on transportation rather than on facilities to help promote community interaction on a regular basis. In addition, 26 day students are transported from 19 communities, with at least 20 vans arriving and departing daily.

The classroom building is a very large one story building with parking underneath one section. The building is approached by the system of walkways which bridges the hilly landscape. The school has an elevated walkway around the entire building, so that all of the classrooms have exterior doors.

There are several entrances used by the students, depending on whether they arrive by van or car or come from another part of campus. Those coming by car have to negotiate a long ramp leading to the perimeter walkway. Students from the campus use the level pergolas/ walkway system, which slopes generally less than 1:20.

The classroom building itself is divided, via an extra-wide and extra-long hallway, into an interior core and exterior perimeter. Classrooms and an auditorium are located around the perimeter walls. The center core contains the large library and media center as well as toilet rooms and lockers. The corridor forms a square around the interior of the building, connecting the classrooms and auditorium with the other uses. The school and its hall has been designed for the simultaneous passage of dozens of people in wheelchairs. There is an oversize quality when one observes the hall without children; it fills up dramatically when all the students are milling and wheeling about.

The auditorium has an unusual design of multiple ramps, each of which lead to a single row, without fixed seating. The stage has an 8" lip around the edge, a functional feature to help guard against falls.

Baylie's Beginning Center

Baylie's Beginning Center was established in 1972 as one of a network of innovative, integrated preschools managed by the Massachusetts Department of Public Health. One of the earliest model programs which integrated children with disabilities with other children, the beginning center predated the legislation mandating education for all children. The school is a day program which runs from 9:00 am till 1:00 pm, with the 16 disabled children coming from 14 nearby communities. Each town has its own transportation, with a total of 16 vans and wagons arriving and departing daily.

Population Description: There are 23 children in the program of whom 16 have disabilities. The program now has a higher percentage of children with disabilities. Social service funding for low income, non-disabled children has diminished. The children range in age from 3 to 6, with 1 child who is 8 years old. The one older child is there because school personnel have been unable to find an adequate public school placement. The children have severe and multiple disabilities, some of which are life threatening. According to staff, "They've lost two children this year". The children and their disabilities include three children who are legally blind, one with severe hearing loss, six who are unable to walk, seven who walk with difficulty and fourteen who have limited use of arms and hands. Seven children use manual chairs, one uses a power chair, two use crutches and three use walkers.

Facilities: The small 5 room preschool facility is located in the lower ground level of the hillside cottage which is the dormitory for some of the younger residents of the Mass Hospital School. The building was built in approximately 1933 for clinical and residential use by people with orthopaedic limitations resulting from polio. It was renovated in 1972 for use as a preschool. The history is unclear, but the present administration's recollection is that the only changes made were in the toilets; that the previously wide doorways provided the basic access. The school looks like most play oriented, child scale preschools with its collection of very small tables, chairs and play environments, except for the array of extra wheelchairs and equipment. There is ample open floor space for playing and group activities as well as three smaller classrooms with tables, chairs and some computer stands.

The toilet room contains a variety of toilet and sink heights; none built to any standard. "Most of the children require some staff assistance". The outdoor playground provides a rich array of structures which can be used by children in wheelchairs or crawling or standing.

Data Collection Approach

Massachusetts Hospital School: The decision to select the Mass Hospital School was based on the opportunity to observe both a wide range of settings and children with a range of abilities. The school has residential as well as educational and recreational settings. We knew that it had one newer facility, the recreation building, which had been built in the 1980's. We understood that it and subsequent major renovations on campus had followed the requirements for architectural code compliance. We also were aware of the respected educational program at the integrated preschool on the same grounds.

A younger and articulate group of children was identified to participate in the study. This was a priority for this study. The preschool provided a limited opportunity to observe another, even younger group. In order to identify and select which settings would provide us with the most pertinent data, a preliminary visit to the campus was made to walk through the potential buildings and to meet with the children and some of the staff.

Design elements in several buildings were evaluated in order to get the widest range of information. These included: the classroom building, with a focus on the entrance, the classroom, the art room, the library, the lockers and the toilets; the residence, with a focus on the bedrooms and the toilets; and the recreation building with a focus on the shower rooms, locker rooms and swimming pool; and the preschool quarters.

The scheduling of the observations had to coincide with bus arrivals and departures and teachers' inservice training, as it was important to see the classroom building in use and meet with a mix of teaching and other staff.

Within the limited time available naturalistic observations of children arriving at both the preschool and the main schoolhouse, in the recreation center around the snack bar and in the residence were planned. The simulations would be in those areas identified by the children during our meeting.

The meeting with the students was full of expressive opinion. Some students were more vocal in offering their impressions but everyone contributed to the discussion, They had pertinent information about many of the accessible elements as well as advice for families to make homes more accessible.

The hour long staff meeting was equally full of opinion and concern. People had come with ideas and expressed themselves freely. The participants included the school librarian, the nurse, the art teacher, a vocational counselor, an occupational therapist and two adaptive equipment specialists.

Baylle's Beginning Center: Further data were collected at the preschool, through physical measures and a meeting with the head teacher and in the residential cottage with two of the children showing us how they performed various activities in their bedroom and washroom. Other than the drop off time and some initial gathering, we did not observe children using the pre-school.

Findings: Massachusetts Hospital School

Accessible Routes: At MHS, accessible routes were always wider than the minimum 36" stipulated for an accessible path in UFAS and the 44" minimum in the Florida standard. *Exterior pathways* were almost always designed to facilitate two-way traffic. Paths were between 7'-0" and 8'-0" wide which provides plenty of room for wheelchairs to continuously pass in either direction.

UFAS stipulates 60" every 200' for passing space, if the path is less than 60" wide.

Only two pathways at MHS were less than 7'-0" wide. The pathway to the administration building was 52" wide and allows for one-way wheelchair traffic. The exterior path to the preschool, down a hill to the lower ground level entrance, was 33" wide (Photos 1 and 2.).

Exterior pathways on hills and inclines were usable with difficulty or not at all for children using manual wheelchairs if their slope was too steep or if railings were lacking. Observations of the children revealed that there were a number of them who were unable to get up relatively gradual *slopes* (1:14) independently. These children had to wait until someone else walked down the path so that they could request assistance.

One striking feature of the MHS that should be noted were the "pergolas", a series of relatively level covered concrete walkways that connect high points on the campus and act as bridges over the low points of the topography. Staff as well as children agreed that the hills at MHS could not be negotiated and that the problem had become much worse since the railings and pergolas which had previously been on hilly slopes were removed for construction (Photos 6-8.).

Interior pathways (halls) which must facilitate two-way traffic were: 16'-0" at Brayton high school, 7'-2" at Baylie's residential cottage, and 7'-0" at the pre-school. Placement of columns in the hall at the Brayton high school reduce the clear corridor width to 10'-6" (Photos 9-10.).

The hallway at Brayton's high school was one of the special design features of the school. Extra-wide and extra-long, it functions as "a drag strip" according to MHS teachers. This hallway was the place where most children learned how to really operate their wheelchairs. Most corners abutting this hallway were rounded which was extremely helpful for children trying to negotiate turns (Photo 11). Corners which were not rounded were chipped and broken, indicating that there have been collisions (Photo 12).

The columns separated the hallway into one 5'6" aisle with lockers alongside it and one 10' 6" general passage area. This enabled children who needed to get lockers open to have plenty of room to move around without bumping into oncoming traffic.
At MHS, pathways which needed to accommodate one-way wheelchair traffic were narrower but still wider than the minimum UFAS standard. The accessible pathways in the high school auditorium were 43" wide (Photo 13.). There was a 52" pathway into the Brayton boys' room and a 51" path into the girls' room. These pathways were one-way because each restroom had two entrances. One point which staff repeatedly made, and which explains the larger than UFAS standard widths along accessible routes, was that children who were still learning how to manipulate their chairs may have less ability to aim themselves and their chairs with precision. A minimum dimension which a skilled adult

might be able to easily traverse may be less easy for an unskilled child to attempt. The wide corridors eliminated any problem with *wheelchair turning space.*

There were no level changes at the Massachusetts Hospital School.

Ramps: Most *ramp slopes* at MHS ranged from 1:12.5 (Photo 4) to 1:9. However, the interior auditorium ramp was very gradually sloped, only 1:29 (Photo 13). The steepest ramp was at the administration building. In general, MHS staff believe that children could not independently negotiate ramps greater than 1:16. UFAS A4.8.2 has also noted that many people cannot negotiate ramps steeper than 1:16.

The *width* of most ramps at MHS was 9'-4". Exceptions were the ramp to the Baylie's cottage (8'-0") and the ramps to the administration building and the high school auditorium. The ramp to the administration building was 4'-4" and the ramp in the high school auditorium was 3'-9". The narrow ramps were intended for one-way wheelchair traffic and the wider ramps are intended for two-way traffic. The narrow ramps in the auditorium were a potential danger during an emergency situation, with only one person able to exit in a line.

Ramps on main pathways at MHS had 8" protruding *edge protection.* No children were observed veering or bumping into the sides of the ramps. At MHS, railings also served as edge protection, since they provide an obstruction at either side of the ramp. Edge protection on other raised surfaces is important. Massachusetts Hospital School had a stage which children occasionally rolled off of before a raised edge was installed.

Handrails were of two types. In and around Brayton high school, handrails were 2" x 7" rectangular wood rails with their bottom edge set at 19" above the ramp floor. A 1-1/2" x 2" rectangular metal rail parallels the wood rail at 32" above the ramp floor. In and around the administration building, the rail was a 1-1/4" diameter cylinder set at 19" to the center line above the ramp floor and a 1-3/4" diameter rail 36" above the ramp floor. There were no observations of the railings being used.

UFAS 4.8.6 and 4.5.1 stipulate skid-proof *ramp surfaces.* Staff at MHS considered skid-proof ramps as critical for access. There were no excessive *cross-slopes*, and all exterior ramps were broom-finish concrete, which seemed to provide sufficient slip resistance.

Elevators: Call buttons were 1" in diameter and were posted at 40-1/2" above the floor (Photo 14.). These were within UFAS limits and higher than ATBCB and Florida minimum standards. Children could not reach the button and felt they were too high. Staff also felt that call buttons were too high and that buttons which required children to isolate one finger and aim it with precision, even a one inch diameter button, made elevators inaccessible to those who cannot reach out and isolate a finger.

The *controls* within the elevator cab were posted so that the highest button was at 52" (Photos 15 and 16.). UFAS specifies that the highest button must not be greater than 54". The emergency button and emergency communications were at 44" AFF. UFAS also requires that emergency buttons must be a minimum of 35" AFF. Children at MHS felt that the elevator buttons were too high, that they could either not reach the buttons at all, or that they could barely reach them.

Staff suggested that the button system of elevator controls be replaced by a mat-driven system. They felt that elevator call buttons and controls, even when placed within reach ranges deemed accessible by UFAS, were not able to be used by all children because they had to be able to isolate a finger and point it at the desired button, a task they could not all accomplish. The elevator was being adapted so it could be called by rolling a wheelchair over a mat. Once inside the elevator (which only travelled between two floors), children could roll over a mat at the back of the elevator to send the elevator to the next floor. In an emergency, a long panel switch would be provided that could be backed into.

Staff also suggested that if more conventional elevator controls were used, these controls must be lowered and that controls should be placed on the side of the elevator cab, rather than at the front.

Doors: With few exceptions, all door clear openings at the Mass Hospital School were wider than UFAS (32") and Florida (36") minimum standards. Clear openings in the Brayton high school were 45" wide with doors open at 90 degrees (Photos 17 and 18.). At Baylie's cottage, doors openings were 42" to bedrooms, 39" to the shower room, and 33" to the bathroom (Photo 19.). All other interior doorways had clear openings of 35". The use of wider doorways reflects the teachers' report that not all children can turn and enter a doorway with absolute precision. Also, children who use communication boards on their wheelchairs,as was the case with several students at Massachusetts Hospital School, often had wide boards which extended beyond the width of the wheelchair. The Florida minimum clear opening standard is recommended, at least 36". Doors at the preschool were variable. Door widths were: 33", 2 @ 35", 39", and 41". However, children in chairs at the preschool tended to be less independently mobile.

All doors except the bedroom doors had *latchside clearance* of well over 18" and maneuvering clearance depth greater than suggested in Figure 25 of UFAS or in the Florida standard. In addition, all doors, except bedroom doors in the cottages, were routinely left open. Two children were observed trying to pull open the bedroom door from inside. One child with full reach was able to open the bedroom door from inside; one child with limited reach could not.

Door openings throughout Mass Hospital School had no *thresholds* except at the preschool, where some doors had slightly varied thresholds. The lack of thresholds at Brayton made for ease of movement.

Knobs were used throughout Brayton and did not conform to UFAS. Doors throughout the school were routinely left open. Door hardware at Brayton varied from 37", 39", 42", and 45" AFF. These heights were all within UFAS standards but were too high to use, according to the children we spoke with. As a result, many children in electric wheelchairs rammed into the doors with their wheelchairs in order to push the doors open. This only worked when doors opened away from the child. Some children were able to use levers, but many could not. The classroom door had a small lever handle and a locking mechanism which was difficult to use.

Exterior doors at the Brayton school required 8 pounds of *force* to open while *interior doors* required only 3 pounds to open. UFAS has a reserved requirement for exterior doors and a 5 pound maximum for interior doors. However, UFAS A4.13.11 notes that adults with severe disabilities cannot even exert three pounds of force.

Children, especially children with substantial difficulties, fit into the category referred to in UFAS A4.13.11. The doors at MHS were too heavy for children who end up having to put their power chairs on "high" and ramming into the doors to open them. Unfortunately, this only works with doors that either open out or have double swing. This is dangerous on heavy glass doors where the glass could break. The fire exit in the classroom where we met with the children was very difficult for the children to open. It was heavy; we did not get the actual door weight. One of the interior doors had a belt on it so that children could pull on a handle and move their wheelchairs. However, children report that opening the door was still very difficult.

Signage: The official bulletin board at Brayton high school was posted with its *bottom edge* at 48". However, throughout MHS, memos and notices of any importance were posted on walls even lower than the bulletin board, between 37" and 48" (Photo 20). This includes official room signs as well as any important notices. This lower height seems to be most effective in placing notices within eye range of children and teenagers using wheelchairs.

Public Telephones: The public phone was hung with the coin slot at 41"

Seating: Seating in classrooms was not fixed. Clearances between seats was variable, making it difficult to evaluate the UFAS based upon observed MHS seating patterns. In general, more than the UFAS requirement of 30" x 48"" clear floor space was present around chairs.

Libraries and Media Centers: *Card catalogs* were built to provide more than 24" of knee space. Drawers were between 29" and 37". The librarian noted that this was effective. The children reported no problems using the card catalogs with these dimensions.

The MHS knee space was higher than the minimum 18" stipulated toe space mandated by UFAS. Also MHS card catalogs were placed in a substantially more restricted range than that allowed in UFAS. UFAS states that card catalogs must be between 18" and 54" with a preferred maximum height of 48".

Books were placed around the perimeter of the library so that there were no *stacks.*

There were three types of *tables* in the high school library: reading tables, computing tables, and typing tables. Reading tables *heights* were 32" with 30-1/2" of *knee space* and 29-1/2" high with 25" of knee space. Computer tables were 32" high with 31" of knee space, 26" high with 25" of knee space and 29" high with 28" of knee space. For some children, the computer tables were too high. For other children, the tables were too low. The staff at MHS emphasized the need for adjustable height tables for tables which were used individually. Heights between 26" and 32" were accommodated in the library. This range is lower than the UFAS 28"-34" range (Photos 21 and 22).

People using computers and other library equipment included children whose legs needed to be fully extended. Fully accessible computer and work stations would allow this extra depth. In the Brayton library, this extra depth was accommodated by placing workstations in the middle of the room so that legs can extend without bumping into walls.

Classroom and Instructional Areas: *Classroom tables* were 29-1/2", 30", 31", and 35" high. Unlike individual workstations which could be adjusted to suit each child's needs, communal tables had to accommodate groups of people. In rooms where children were doing very active work on tables, such as the art room, Mass Hospital School accommodated the need for variety and adaptability by providing a range of tables, large and small, of different heights, and one adjustable table. The height of the main table in the high school art room was 29-1/2 inches. Tables in other classrooms were 30", 31", and 35" high. These tables were used by children as well as MHS students in their early twenties, which may explain why some tables were so high (Photos 23 - 25).

Leg placement on tables was another issue for communal tables. Tables with many legs especially at the corners created problems when many kids using chairs were trying to gather around a table at one time or when many of the children could not aim their chairs precisely. Pedestal tables were discussed as an alternative.

Controls: *Wall-mounted objects* at MHS range between 47" and 51" AFF. All were too high for children to reach. The UFAS standard cites an adult reach range from a wheelchair as between 15" and 48". Therefore most controls were above the UFAS standard. However, controls that fell within the UFAS reach range for adults (47") were too high for children.

Most *fire alarms* were located at 48" AFF. The only accessible switches were the emergency call switches which were placed on walls and in toilet stalls, all at 36" AFF.

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The *chalkboards* were mounted with their lowest point at 28" AFF, which was acceptable. Staff felt that the friction of chalk on chalkboards made the use of this type of teaching aid difficult for children with arm and motor impairments. They suggested that dry-erase "white" boards would be easier for the students to use than chalkboards.

Storage: Standard *lockers* at Brayton had front latches at 46" AFF and bottom shelves at 10" AFF. They were unusable by some of the students.(Photo 9) Several lockers had been made accessible. Accessible lockers had a front latch operable with a closed fist at 32" and a bottom shelf at 29". *Clothing rods* were at 55", too high for children to reach and one inch higher than the UFAS standard of 54". However, as the children demonstrated, 55" is also clearly too high for children.

Storage in the art room is variable, with *shelves* at 2"-18"-36" on one unit, and 15"-35"-45" on another.(Photo 26).

The *clothes storage* in children's' bedrooms at Baylie's Cottage was difficult for children who had limited reach to use. *Clothing rods*, located at 31-1/2", were too high. The rods, located 10" back from the front face of the cabinet, were unreachable by the students who demonstrated their use.

Additional information was obtained on the accessibility of furniture used for storage. The top of the bureau, at 48" AFF was also considered too high by the students. One girl with good reach was able to reach the bureau knob and shelf at 36". Another girl with limited reach was not able to reach shelf at all (Photo 27). While the bureaus knobs were clearly inaccessible, the difficulty that one girl had in reaching to a point 31-1/2" off the floor and 10" into the depth of the bureau indicates that reach restrictions need to be addressed in the standards. Nightstands with 10" clear space and doors without accessible hardware were considered difficult to open. The top of the nightstand was at 32" AFF.

Toilets: *Toilet heights* varied in different buildings at Massachusetts Hospital School. In Brayton High School, there were nine toilets: four in the boy's room and five in the girl's room. All were at 16" AFF. The Brayton rest rooms were considered to be among the best at the school (Photos 28-30). The children interviewed said that the toilets in Brayton were at a good height and children with good reach and motor control could transfer by themselves. The toilets in the gym girl's and boy's rooms were at 17" AFF. These were, according to one of the children interviewed, "awful, awful, awful." They were too high and stalls lacked commode chairs. Children had to be lifted onto the toilet seat which they disliked.

In Baylie's Cottages, one toilet was at 14" and two were at 18". Stalls had commodes which made transferring easier, and children all agreed that commode chairs were crucial in allowing them to transfer by themselves (Photos 31 and 32).

Grab bar heights varied from bathroom to bathroom. At the Brayton boy's room, the grab bars were posted at 34". At the girl's room, they were set at 34" at the side and 36" at the back. Grabs bars in the gym bathrooms were even higher, set at 42" at the back and 34" at the side. At Baylie's cottage, bars were set at 31". At the preschool, they were at 20" in one stall, at 16" on the side and 23" at the back in another stall.

Two students were videotaped transferring in Brayton and two transferring in Baylie's cottage. One of the participants who was one of the shortest children but who had good reach, was able to transfer onto the 16" toilet using a side transfer and leaning on a shower chair. A second used a standing pivot transfer, tried to transfer but began to fall. She needed assistance from the nurse attendant to complete the transfer. Both children depended on the chair back and arms of the commode for use in steadying themselves. Neither child used a front approach to transfer.

Flush controls were substantially lower than the UFAS standard of 44" and lower than the ATBCB revisions and the Florida standard maximum. Flush controls were at 23" AFF in Brayton restrooms and 25" in the Baylie's cottage toilet room.

Toilet paper dispensers were at 28" and 29" AFF at Brayton high school. This was higher than the UFAS 19" minimum.

In the boy's room, toilet paper dispensers were 24" from the back wall. In the girl's room, two dispensers were at 18" from the back wall and two were at 14" from the back wall. Children who could reach said they had no difficulty reaching toilet paper. It is recommended that toilet paper rolls should be placed between 18" and 24" from the back wall.

In the gym, toilet paper dispensers were 19" AFF and at Baylie's cottage, they were at 24" AFF and 30" from the back wall.

Urinals: There were urinals in the boy's bathroom in Brayton and the gym. In Brayton, there were 4 urinals with their rims at 22" AFF (Photo 32). At the gym, there were two urinals with their rims at 24" and two with their rims at 14" AFF. The UFAS standard stipulates that urinals be placed with their rims at 17" or below. None of the students who could use urinals had difficulty with the ones provided.

There was more than 30" x 48" square *clear space* in front of the urinals.

Controls for urinals were 48" above the floor, higher than the UFAS 44" maximum.

Toilet Stalls: Toilet stall configurations varied from building to building and also within individual restrooms. At Brayton and Baylie's cottage, many configurations were provided to respond to different needs and abilities. At the gym, stalls were smaller, not compliant with access standards, less equipped with specialized equipment, and more difficult to use.

Brayton *toilet stalls* were all 59" long. Widths were 33", 34", 68", 59", 62", and 62". The narrower stalls had parallel grab bars on both sides which can be held while transferring. The 68" wide stall also had bars on both sides but not at the back. However, this required a frontal transfer which was difficult for most of the children to complete independently, and there was insufficient room for an assisted transfer. The 59" x 59" stall was the most popular one for children. This configuration allowed sufficient floor clearance space to complete a side or angled transfer independently or with assistance. The 59" x 62" stall had a changing table and hose with water attached to the toilet and is for children who need more substantial assistance. UFAS has no guidelines which stipulate a range of options in bathrooms with multiple fixtures, but it should be noted that it was precisely this variety which allows all of the children at Brayton to gain access to the bathroom.

The 59" x 59" stall included 31" long grab bars set at 34" AFF on side walls and 36" AFF at the back wall. The toilet paper dispenser was 29" AFF, the toilet seat was at 16" AFF, the toilet center line was 17" from the left stall wall. There was a commode in the stall. As with the other stalls in this bathroom, there was no stall door. Instead, a curtain was used to provide privacy.

The 59" x 62" stall was configured to allow for assistance (Photo 29). The *toilet seat* was 16" high with a clean water hose attached which was set at 43" AFF. There were *three grab bars*, each 31" long, set at 34 " AFF at the sides, and 36" at the back. A fold-down changing table was 18" wide by 49" long and was set at 43". Directly outside this stall, there was a changing table and a folded screen so that the stall can effectively be extended (see sketch). A changing table, hospital table, chair and trash can were in this area.

In the gym, bathroom stalls were 60" x 72" in the boy's room and 71" x 56-1/2 " in the girl's room. At Baylie's cottage, the stalls were 60" x 60". In general, children felt that these stalls were too small and wanted more space. One girl noted that she had been in large accessible stalls in restaurant bathrooms and that the extra space was helpful.

Bathroom Doors: All bathrooms had *clear space* well in excess of 5 foot square. This clear space was necessary in bathrooms which accommodated many people in wheelchairs. It should be noted that UFAS minimum standards do not presume that more than one person who uses a wheelchair will try to use a restroom at any one time.

Door Clearances into Brayton toilet stalls varied, with clearances at 22", 25", and 59", 62" and 68". Narrower openings were for narrower stalls. All stalls had curtains instead of doors.

Clear openings into girls' bathrooms in the gym were 35" with conventional stall doors which lacked latchside clearance.

Lavatories and Sinks: At Brayton *sink rims* were at 30" in the girls' room and 31" in the boys' room (Photo 33). Gym sinks were at 32" (Photo 34) in Brayton and were too high for children to reach the sink hardware or faucets. Sinks were spaced 16" apart, so in order to turn on the water, children wheeled themselves in between sinks and approached sinks from the side. UFAS standard sinks with maximum rim height at 34" AFF and minimum knee clearance of 29" would be too high for use by children.

Sinks in the Baylie's residence were 26", 27", 28" and 29" (Photo 35). Some children found sinks in the Baylie's residences to be too low. Rims at 28-9" seems to be about the right height for children.

Vertical clearances were between 27" and 29" in the high school and gym and 23" and 25" in the Baylie's residence.

Sink controls were the primary reason that sinks were difficult to use. Children at MHS complained about the inaccessibility of Brayton sinks. Faucets and hardware were out of reach for children with limited reach or short arms. As noted above, children could not reach faucets or hardware by using a standard front approach to the sink and had to wheel to the side. Children suggested that longer hardware might help. The adaptive designer at MHS cited sinks as one of three areas in which changes were crucial in order to provide enhanced access.

MHS staff were particularly proud of an adapted sink in the art room and felt that the lessons they learned in adapting the sink could be more widely adopted (Photos 36 and 37.). Although the art room sink was high (at 34" AFF), and piping below the sink blocked knee and toe clearance, it had several special features which made it the only sink accessible to the most severely disabled students. A shallow wire basket was hung in the sink (a standard metal kitchen sink) to serve as a drainboard and allow access for kids who were unable to reach into the depth of the sink. Sink hardware was placed on the front apron of the sink. Access to the sink was via a side approach from the left. Consequently, lever handles for both hot and cold water were placed at the right front apron of the sink to prevent the levers from being banged by wheelchair traffic. The temperature controls was reversed so that the cold water was on the left and the hot was on the right. Staff purposely designed the sink so that the cold control was the lever closest to the children. They felt that this prevented children who could not reach the second handle from burning themselves with hot water.

The faucet was extra long and swiveled so that it extended beyond the front counter edge. This was good for filling up pails and allowed water to come as close as possible to the children. This sink was very popular with children at MHS. Some adjustment to UFAS standards to include forward placement of sink hardware and faucets is recommended. Use of shallow sink basins, and reversal of handles is also suggested.

Bathtubs: There was a large institutional bathtub with an hydraulic chair lift in the Baylie's cottage shower room (Photo 38). The tub had a 36" *clear space* at the two long sides and 48" at the short side. The tub itself was raised and wholly inaccessible without a lift. As the lift was located at the short end of the tub, children were not required to travel along the 36" passageways at either side of the tub. *Grab bars* near the tub were placed at 30" AFF.

Showers: Baylie's shower room also has a *floor space* of 60" x 77.5" with full wrap-around *grab bar* at 31"AFF (Photos 39 and 40).

Gym showers include individual showers and gang showers. Individual showers were 60" x 32", meeting UFAS standards. Seats were 16" (Photos 41 and 42).

None of the showers had a curb or lip.

Shower Controls were placed along the back wall of the shower near the water hose. Controls were placed so the bottom of the lever was at 31 1/2" and the top of the lever was at 36 1/2". *Grab bars* (30" long) were mounted at 36" AFF. The shower connection was set at 37" AFF with the hose travelling from this connection and hooked above at 68" AFF on a thin vertical "grab bar" 3/4" in diameter and 31.5" long.

One of the children complained about the placement of the *controls* in relation to the shower hose. The controls are placed so that it is difficult to adjust the water without actually being in the water. This is particularly true for children who do not transfer onto shower seat but bathe in a rolling chair. Current standards do not address this aspect of the relationship of the controls to the placement of the hose or other shower fixtures.

Mirrors: Mirrors were placed with their *bottom edge* at 40" in the Brayton boys' room, 41" in the Brayton girls' room and 34" in the Baylie's shower room. The Brayton's mirrors meet UFAS standards but were too high for children to see themselves. Staff suggested placing mirrors in non-bathroom settings, such as over a stove, to help students understand horizontal surfaces.

Drinking Fountains and Water Coolers: *Spout heights* varied between 28" AFF at Baylie's and 37" AFF at Brayton, which was 1" higher than the maximum in UFAS (Photos 43-45). Children did not appear to have difficulty with the height.

All spouts were located at the front of the unit. Children did not appear to have difficulty with the location.

Controls were all button or push-bar type, except for the lobby fountain at Brayton which also had a lever at foot level. Children did not appear to have difficulty with the controls.

All units were cantilevered off the wall. *Knee space height* varied between 20" AFF at the Baylie's unit and 30" AFF at the Brayton units. *Toe space* always exceeded the 9" required by UFAS, and knee space depth always exceeded the 8" required. It was 13" at Brayton.

Public Telephones: All phones complied with *height and floor clearance* requirements, and the phone at Brayton was equipped with a volume control. The phone at Brayton was installed at an exceptionally low height, 44" AFF to the coin slot.

Restaurant and Cafeteria: No building at the MHS had a cafeteria which resembled those diagrammed in UFAS. There were kitchen facilities in Brayton and Baylie's and a snack bar in the gym.

In the kitchen at the high school, the counter was 32" AFF with 27" high knee space. The stove had front-mounted controls, and there was accessible knee space under the sink (Photos 46 and 47). At Baylie's cottage, the kitchen counter was also located at 32" AFF, was 25" deep and had 30" clear knee space below. The dining room table top was 33" AFF, with 31" knee space below. The children commented that there were no accessible kitchen facilities at the MHS. It was difficult for their wheelchairs to fit under the sinks, and one girl asked that the counters be lowered.

The snack bar counter at the gym seemed to work quite well (Photos 48 and 49). The counter was 32" AFF, with a section located at 28". Knee space was 26" high and 18" deep, and these dimensions accommodated most students. Utensils were located in a tray on a table 35" AFF. The work counter was also designed for accessibility, having the same dimensions as the high portion of the counter.

Standard vending machines were located in the snack bar area. These machines were difficult to use and most of the students observed required assistance in operating them. The highest operable part was 66" AFF. Reach spaces for obtaining food were difficult for people with no fine motor control problems. One was located 20" AFF, but was only 3" high and required a 9" reach to get to the food. All coin return openings were only 1-1/2" x 1-1/4". The vending machine area was popular with students, despite the relatively inaccessible designs.

Additional Considerations: *Changing tables* were not addressed in UFAS. The changing tables at the MHS were usually 34"-36" AFF and were generally considered by the students to be too high to be used independently, although some were 22" AFF. One student with poor balance control mentioned being scared on the table and wishing there were straps to hold him down. Students also felt the changing tables were too narrow (usually 30") (Photos 51 and 52).

The *pool* at the gym was fully accessible, having a ramp leading into the shallow end. One feature which greatly enhanced the usability of the pool was a bench along both sides, located below the water line and running the length of the pool. This allowed students who have difficulty standing to rest in the water. Staff commented that the bench enabled them to teach better. Students were able to rest in the water and teachers did not have to lift resting students out of the pool when another student was being instructed.

Windows at Brayton had accessible lever hardware which was located between 29-1/2" and 33" AFF. Windows swung in, rather than out, so that the reach range required for operating windows was decreased. Windows at Brayton span the full height of the wall, from ceiling to floor, with the operable portion of the window placed at the floor to facilitate access.

Windows in the Baylie's cottage bedrooms, by contrast, were standard double-hung with inoperable latches 57" AFF. The two children we videotaped and interviewed at Baylie's cottage, one with good reach, the other with limited reach, could not operate these windows.

Beds, at 27", were too high, and difficult to transfer onto. Several children mentioned problems with transferring onto beds.

Findings: Baylie's Beginning Center

Preschool children at the Massachusetts Hospital School are educated at the Baylie's Beginning Center. Sizes and features at the preschool are substantially different than dimensions throughout the rest of the campus. They are therefore presented separately.

The preschool lacks some conventional "accessible" features. Entryways have thresholds, floor surfaces are uneven, and there are climbing structures in the school (Photos 1 and 2.). Children at the preschool are light enough and small enough that they can be easily lifted and/or can crawl to areas which would be inaccessible to children or adults using wheelchairs.

Important dimensions which can be gathered from the preschool are height of chairs, tables, toilets, sinks, and operating controls. Other items, such as pathways, doors, and clear spaces should be built to accommodate the older child or adult. It is our recommendation that standards for preschools do not presume a completely able-bodied care-taker.

Accessible Route and Drop Off: The road leading up to the preschool was 9'-6". There was no *access aisle*. The road led directly to the door of the preschool. This was a problem as only the first vehicle in line was in a place where children could disembark on a level surface. Children who were unloaded down the driveway had to be carried or pushed in wheelchairs over a grassy, hilly area to reach the entry to the school.

Classrooms and Instructional Space: *Tables* are 17" high with 16" of *clear space* and 31" of *clear passage space* around each table (Photo 3). Children do not sit in their wheelchairs at the table; they transfer to smaller chairs. Although we did not observe this, teachers felt that this transferring was preferable and allowed children to be more fully together. We observed one boy crawling out of his chair to join other children.

Toilets: Preschool *toilet heights* were variable, at 11", 16", and 17."

Toilet Stalls: There were three partitioned areas at toilets in the preschool. One was 55" wide by 28" deep. The other two were 32" wide by 28" deep (Photo 4). Toilets are 16" high. *Grab bars* were placed 20" AFF and to one side in one of the stalls. In another, there were two grab bars, slanting backwards at a diagonal. There were several pieces of equipment lying about the stalls (see Photo 5). There were commodes with footholds for use with toilets. *Flush controls* are 21" AFF. The *toilet paper dispensers* were 16" forward from the rear wall and 32" above the floor. None of the children used toilets independently. It was not clear whether larger stalls would enable more independence. At the preschool, none of the stalls had doors. The two narrow stalls had 24" wide openings.

Lavatories and Sinks: *Sinks* were placed with their rims 28" above the floor (Photo 6). *Vertical clearance* from the bottom of the apron to the floor was 25". *Knee space width* was 25" and depth was 18". *Faucets* were 14" from the front of the sink. At the sinks, some children were helped to stand on step stools. The teachers said that the sinks worked well for children who used chairs to approach sinks. *Mirrors* were placed with their lower edges at 35" above the floor.

Controls: Controls such as *light switches* were 48" AFF at the preschool. The *fire alarm* was 47" AFF. These were clearly too high to be accessed by preschoolers.

Conclusions: Mass Hospital School

Accessible Routes:

The MHS *pathway* width of 7'-0" to 8'-0" seems to work well and seems particularly appropriate for community locations such as schools in which continuous two-way traffic can be expected.

UFAS 4.3.7 stipulates that *slopes* greater than 1:20 must be treated as ramps. This standard seems to be an important one to maintain in standards for children. In our meeting with children at MHS, sloped pathways without *railings* were identified by the children as one of the problems they would most like to see fixed.

For hallways which need to accommodate activities as well as two-way passage, the space needed for each of the desired activities should be added up to determine desirable width. Where wheelchairs might customarily stop and be stationary or attempt a complex maneuver along a route, such as opening a locker, a clear open space adjacent to, but not within, the accessible route should be provided.

A general issue repeatedly stressed by MHS staff is that children are still learning how to maneuver themselves and their chairs. Therefore, while miniaturization of adult standards is appropriate for some items, particularly those involving height and reach range, it is not appropriate for *clear floor space* and *clear opening widths*. In fact, children may need more space than adults because they are still learning how to aim themselves with precision through relatively narrow passages.

Ramps:

UFAS 4.8 and UFAS Figure 16 stipulate that a *level landing* must be provided for every 30 foot horizontal run of ramp. MHS staff believed that a ramp should not be longer than 20'.

As with accessible routes, UFAS standard *widths* for ramps assume one-way single file traffic. In situations in which substantial two-way traffic can be presupposed, wider ramps are advisable. If a ramp is used as part of an accessible route to an emergency exit and many people using wheelchairs may be occupying a building, a wider than minimum ramp width may prevent a potentially hazardous situation in an emergency.

Ramps and any raised platform must have *edge protection*. Railings on the sides of ramps can work as edge protection. Stages and other platforms must have a raised edge to prevent accidents. The raised edge at the MHS stage was 8" high.

Handrails at MHS were substantially lower than current UFAS standard recommendations. UFAS cites rail heights of 30"-34". ATBCB recommendations suggest 26"-28". Even Florida standards (24"-30") were higher than what we found at MHS. MHS railings were set at 19" AFF and 36" AFF. We recommend that UFAS stipulate two railing heights, the standard 30"-34" for adults and a lowered railing for children. We believe that children's railings should be lower than stipulated in any of the prevailing standards.

Elevators:

Discussions with MHS staff revealed that current methods of providing accessibility in elevators are not universal enough to meet the needs of children with severe disabilities. Staff stressed that a truly universal system of *controls* would require that a child do little more than bump his or her wheelchair into a wall or roll the chair over a mat. Traditional elevator buttons, which require that a child isolate a finger to select a button were not usable by severely disabled children. In particular, *emergency buttons* and call switches should be fully accessible to severely disabled child. Currently, a severely disabled child trapped in most elevators would not be able to reach or maneuver an emergency switch to call for help. The observations of MHS staff suggest the development of new systems of controls, and we recommend that further work be done on the development of universal controls for elevators and that UFAS advocate for the addition of universal controls into elevator cabs.

At a minimum, MHS staff suggested that elevator controls need to be lowered and that controls should be placed on the side of the elevator cab rather than in front.

Doors:

UFAS currently requires a 1/2" bevelled threshold or the elimination of *thresholds*. The children we observed had problems even with 1/2" thresholds. We recommend that UFAS stipulate the elimination of thresholds on all interior doors for which thresholds serve no purpose as a sound or heat barrier.

Children may have difficulty aiming their wheelchairs with precision. Children who use communication boards need wider than minimum door openings. Florida minimum standards for door *clear opening* (36") are better than the UFAS standard (32"). The doors we saw children use were substantially wider than the Florida or UFAS standards.

UFAS A4.13.11 notes that many adults cannot exert even three *pounds of force*. Children, especially children with severe disabilities, fit into the category referred to in UFAS A4.13.11. The UFAS 5 pound maximum for interior doors is too heavy for children.

Not all children could use what is traditionally thought of as accessible *hardware*. Levers were not usable by many children. Kick-plate hardware, which requires only bumping of a wheelchair into a door, might work better.

Signage:

Optimal placement for *signs* is between 37" and 48".

Libraries and Media Centers:

Card catalogs at MHS had a higher knee space and a more restricted reach range than the UFAS minimum standard. These card catalogs, with drawers between 29" and 37" and knee space of 24", worked well.

In specifying depths of *tables and work spaces*, the UFAS does not consider the needs of children (or adults) who must have their legs fully extended. UFAS stipulates only a minimum knee space depth of 19" which would not be enough to accommodate those who must extend their legs. Positioning some library and computer tables in the middle of rooms allows all children to gain access to work surfaces.

Table heights were between 26' and 32" AFF. This range is lower than the UFAS 28"-34" range.

Classroom and Instructional Areas:

In classrooms, as in the library, *table heights* were variable. In classrooms, tables were between 29-1/2" and 35". The importance of adaptability in work surface height was repeatedly mentioned by MHS staff. Because children are constantly growing and changing in size and because the range of potential disabilities children may have is so wide, staff felt that adaptable rather than universal design was the best way to accommodate children's needs. The notion of adaptability was so often invoked by staff and its application seemed so important to the success of the Mass Hospital School that we feel that some mention of adaptability should be made in the UFAS. Adaptability can obviously be achieved via adjustable furniture and equipment or through a range of work surface options.

Placement of *table legs* can be problematic when many children are gathering around a table, especially when several children cannot aim their chairs precisely.
Pedestal tables were recommended as an alternative for tables around which groups must gather.

Controls:

MHS staff felt that light *switches* needed to be lower and more accessible. Controls posted at 47", within the UFAS adult reach range, were too high for children. They also felt that pencil sharpeners and telephones needed to be lowered and that use of controls should not require grasping, isolation of a single finger, or other fine motor activities.

Various methods of making switches accessible were suggested by MHS staff who stated that total accessibility in operation would require a child to do little more than bump his/her wheelchair into an area or roll over an area. A mat which was located in a room and could be rolled over to activate or turn off lights was one suggestion. An infrared system which automatically turned on lights was another.

Large rocker switches were discussed and staff felt that they were better than typical toggle switches, especially for children who use pointers; but that rocker switches were still not universally accessible.

Staff felt that *fire alarms* should be low (between 30"-36") and should require no more than a simple touch.

Dry-erase boards are better than *chalkboards* for children with arm and motor impairments.

Storage:

In general, children could only *reach* a few inches up or away from the wheelchair. Design specification, therefore, should not presume the type of full armed sweep diagrammed in Figure 6 of the UFAS. Most of the children we observed could not reach the majority of the storage areas. The 54" maximum allowed in UFAS is clearly too high for children.

Toilets:

One of the most important findings regarding bathroom accessibility and children was that the children videotaped did not or could not use *grab bars*. Leaning to the side and back to grab a bar would be difficult for all of the children and might have caused them to fall back into the toilet seat in a way that would be difficult. Children needed to steady themselves by leaning forward as they transferred, not to the side and back. Even for children with good reach, their short arms left the grab bars out of reach at the point of transfer, just when steadying was most needed, although a side bar could be of help for a standing pivot transfer when used in conjunction with a commode.

Commode chairs were crucial. Children leaned on the back of the seat, on the chair arms, and on the chair seat in transferring. Since chairs were on wheels, children were able to move the chair around to accommodate different stages of the transfer. A mobile steadying device such as a chair is not currently required by UFAS but should be considered as a new addition to it. Children who were fully able to transfer independently with a chair probably would not be able to transfer without it. The chairs at MHS are likely modified commodes, with the bottom cushion of the chair able to be lifted out so that the chair turns into a commode. Children who have reach problems and could not transfer independently vastly preferred using a commode to being lifted onto a toilet seat. The commode/shower chair therefore serves two purposes.

Toilet heights at 16" are best. Higher toilets were extremely difficult to transfer onto.

Flush controls were substantially lower than the UFAS standard of 44" and lower than the ATBCB revisions and the Florida standard maximum. Controls were between 23" and 25". These lowered controls should be considered for UFAS.

Toilet paper dispensers were 28' and 29", higher than the UFAS minimum of 19". A higher minimum might be considered.

It is recommended that toilet paper rolls be placed between 18" and 24" from the back wall.

Toilet Stalls:

UFAS has no guidelines which stipulate a range of options in bathrooms with multiple fixtures, but it should be noted that it was precisely this variety which allowed all of the children at MHS to gain access to the bathroom.The best restrooms have a range of toilet stall options or toilet stalls which are individually adaptable.

The UFAS does not currently address the need for *changing tables* or special *disposal cans* for medical waste. The UFAS also does not consider the space needed for assisted procedures in bathrooms. These are crucial and should be addressed in any standard to meet the need of children.

Lavatories and Sinks:

The UFAS maximum *lavatory height* of 34" is too high for children. A sink rim maximum of 30" is recommended. 28"-29" appears to be an optimal height for sinks.

Sink controls and faucets must be placed towards the front of sinks to allow access for children. This change is one of the most crucial in allowing enhanced access for children.

If hardware is placed on the front apron of a sink, both knobs should be grouped together, with one knob over the other or with both knobs side by side. This will eliminate the problem of having to aim a wheelchair between two knobs, and will minimize damage which could be caused as children using wheelchairs bump into protruding levers. The cold faucet should be the top faucet or the faucet closest to where the child will be sitting. Placing hardware on the front rim rather than the front apron will eliminate the possible problem of children bumping into protruding levers. Again, the control for the cold water should always be the control closest to where a child using the sink would sit.

Shallow sinks are important for children with limited reach.

Shower Controls:

Shower controls at MHS met Florida standards and is substantially lower than UFAS maximum standards of 48". We recommend that the lower standards be used, with lever hardware 5"+ long mounted at a height of not above 36".

Current UFAS standard configurations for shower hoses in relation to shower controls do not enable many children to adjust the water without actually being in the water. A new standard which requires the placement of controls at the edge of a shower stall is recommended. Adults and children should be able to adjust and test the water without being directly underneath a full spray of water.

Mirrors:

Mirrors which meet UFAS standards for adults are too high for children and must be lowered.

Public Telephones:

Public telephones must be lowered, reflecting the more limited reach range of children. A scoop type coin slot which could be used by tossing a coin into a funnel would be better for children and adults with limited hand use.

Restaurant and Cafeteria:

Counter space is optimally located at 28"-29" for younger children and at 32" for older children. *Mirrors* over counters and stoves allow children to understand horizontal surfaces.

Vending machines should at least be required to conform to standard reach requirements, and an attempt should be made to accommodate individuals lacking fine motor control.

Additional Considerations:

Changing tables should be included in accessible stalls and the UFAS should have specifications related to the height and width of tables. Tables which are too high scare children. Tables should be at least 30" wide and perhaps wider. Straps may be helpful to some children being changed but perhaps demeaning to others.

Windows should be covered in UFAS. The windows at the Brayton high school worked well and could serve as a starting point for a new standard. UFAS has reserved decisions on windows. Lowered windows with accessible hardware which swing inward and require limited pull force reportedly work well for the children at MHS. With lever handles located between 29-1/2" and 33", these windows were not too low for the elderly while meeting the needs of people who are small and children who use wheelchairs.

To be accessible for independent transfer, *beds* must be very low, approximately the height of an accessible toilet seat (16-7").

Conclusions: Baylie's Beginning Center

Toilets:

Toddlers must be assisted to use toilets. Toilets for disabled toddlers, like for able-bodied toddlers, should be miniaturized.

Toilet Stalls:

Because most children must be assisted, it is helpful if toilets are configured to allow for an adult to help the child.

Lavatories and Sinks:

Sinks must be lowered and room must be provided for adults to help children at sinks.

E. RIVERS ELEMENTARY SCHOOL
ATLANTA, GEORGIA

Site Description

The E. Rivers Elementary School was built in 1949 and was renovated in 1989 to be accessible to disabled students. The school is located in an affluent, in-town neighborhood in Atlanta, Georgia, but the school is a magnet school serving children from the entire city.

Population Description: The E. Rivers School serves a total of 250 children in grades K through 6. Three students were orthopedically disabled. Two of these students were able to participate in the site visit. One fifth grade student with cerebral palsy was ambulatory and used Canadian crutches. This student had attended E. Rivers since the first grade, prior to its renovation. The other student, a second grader, also had cerebral palsy. He used a wheelchair and crutches.

Facilities: The school is located on a site that slopes away from the street. The school building is two storeys, with the upper, main level of the building located at street level. The administrative offices, library, auditorium and most of the classrooms are located on this level (Fig. 1). The lower level, accessible from the main level by an elevator and stairs, contains the cafeteria and some classrooms. A large covered play space is located outside of the lower level, at a slightly lower grade.

Accessibility modifications had been made to the front entry area, an elevator had been installed, some water fountains had been lowered, and bathrooms had been modified (Fig. 2).

Data Collection Approach

Facilities Evaluated: The evaluation at the E. Rivers School concentrated on the accessibility retrofits noted above. Limited information was obtained on the accessibility of unrenovated spaces (interior and exterior) and design features at the school.

Data Collection: The data collection followed the general protocol established for Task 3. Physical measurements were obtained for the accessible features as well as other critical measures that had not been modified; for example, clear door widths. A small group discussion was held with the teachers who were teaching or had taught disabled students at E. Rivers. This discussion focused on their experiences of how well the building worked for these students, and needed changes. A second discussion was held with the two students who were available to participate. This discussion focussed on how well the building worked for them, and what additional accessibility modifications were needed. Following the discussion with the students, they accompanied the research team on a tour of the building and demonstrated selected accessible features.

Findings

Accessible Route: The accessible route into and out of the school is through the main entry. The school's double front door has been modified with a short ramp on one side to eliminate the 2.5" difference in grade between the main level and the front sidewalk (Photos 1-3). The door on the modified side of the entry was found to be latched open on each of the research team's three visits to the site. The driveway is reached from the sidewalk at the main level by a ramp that has been cut into the sidewalk (Photos 4-5).

The second grader experienced great difficulty in egressing the main entry due to the amount of effort it took for him to propel the front wheels of his wheelchair over the threshold (.5"). After several unsuccessful attempts, a staff member had to assist the student by pushing his chair over the threshold. This student experienced no problems in using the ramp, including stopping at the bottom and maneuvering his wheelchair to be perpendicular to the driveway where he was picked up and dropped off.

In contrast, the fifth grader who used Canadian crutches reported that the short ramp at the main entry was difficult to use. He preferred to use the unmodified side of the main entry, even though the door on this side of the entry was seldom left open.

Classrooms opened onto an interior corridor and onto an outdoor play space (Fig. 1). The outdoor play space was several inches lower than the classroom floor. This change in surface levels had not been modified. Consequently, staff had to assist the second grader in getting outside from the classroom.

Ramps: Two ramps were intentionally installed at the E. Rivers School; one at the main entry door and the second from the front sidewalk to the driveway. A third ramp was created at the intersection of a classroom wing corridor (Fig. 1) and the corridor of the administrative wing. The *slope* of the short ramp at main entry was 1:10; the sidewalk ramp was 1:11.5; and the interior corridor was 1:20. The ramp at the main entry ended at the threshold of the exterior door. There were no landings at the top of the entry ramp or at the bottom of the sidewalk ramp.

The second grader was unable to ascend the short ramp at the main entry. While this ramp is steeper than the maximum allowed under UFAS (1:12), it is likely that a number of factors contributed to his difficulties. First, the thin front edge at the bottom of the ramp had broken off, leaving a ragged edge that approached 1" higher than the sidewalk (Fig. 1). The retrofitted ramp was made of concrete and poured in place over an existing concrete sidewalk. Concrete will not hold a thin beveled edge, such as that needed at the bottom edge of a ramp, under these conditions. Second, there was no landing at the top of the ramp. While the site visit was conducted during warm weather when the exterior door was latched open, the absence of a landing would create problems if the door was shut. Third, the child had limited upper body strength, and could not propel his chair up the ramp unassisted (Photo 1).

The second grader came close to losing control of his wheelchair while demonstrating how he descended the ramp that had been cut into the sidewalk at the front entry (Photos 4 - 5). He was unable to ascend the ramp unassisted. This ramp was surrounded on its upper edge by a rail. However, this rail was intended to prevent falls onto the ramp and not to assist in ascending or descending the ramp. The ramp was not enclosed on its open side.

Stairs: The fifth grader who used Canadian crutches was skilled in using the stairs that linked the main and lower levels of the school. He reported that they did not present any problems, although he depended entirely on the handrails to maintain his balance.

Elevators: A small elevator had been installed as part of the accessibility modifications to link the two levels of the school. *Call buttons* were installed at 30.5" AFF, which is slightly lower than the height recommended by the Children's Supplement. *Call buttons* were 1.25" square, almost twice as large as the UFAS minimum diameter (.75"). The *hall lanterns* were 44.5 AFF, over two feet lower than the UFAS requirement (72") and nearly 18" lower than the Florida Standard's recommendations. The *entrance markings* were 60.5" AFF.

The elevator was locked and staff had the key. Students could not use the elevator unless accompanied by staff.

Doors: The clear width of passage doors ranged from 33.5" to 36.5" No doors had been modified. No problems with clear door width were reported. As discussed above, the threshold at the main entry door (.5" and beveled) presented a problem for the child in the wheelchair when egressing the building. The front door was equipped with a push bar on the inside (40" AFF), and a U shaped handle on the exterior (38" CL AFF). This door required 10 lbf to open. The fifth grader who used crutches had no difficulty in opening the main door, and holding it open to enter the building. However, he appeared to have excellent upper body strength, and was very adept in using his crutches to help hold the door open.

Staff reported that the bathroom doors were too heavy for the disabled children to open (16.5 lbf).

Curb Ramps: No curb ramps were provided at the bus pick-up/drop off zone.

Signage: Signage had not been modified to be accessible. Neither staff or students reported any difficulties with the existing signage.

Libraries and Media Centers: No modifications had been implemented in the library. The librarian reported that, in general, younger children could not reach books stored on upper shelves of the bookcases that surrounded the room. The ambulatory fifth grader was not observed to have difficulty in taking books off the shelf, but the second grader, in his wheelchair at the time, was not able to reach the three upper shelves.

Classrooms: No architectural modifications had been made to the classrooms. Classrooms were divided into activity areas. Teachers reported that the size of the classrooms, number of activities and number of students left little room for maneuvering a wheelchair. This problem was exacerbated by the second grader's limited skills at maneuvering his wheelchair. The classroom used by the second grader contained a commercially available adjustable table. Light switches were installed at a height that could only be reached by adults.

Storage: Storage had not been modified to be accessible. Neither staff nor students reported any difficulties with the existing storage, except for the absence of coat racks or hooks low enough to be reached from a wheelchair.

Toilets: The boys and girls bathrooms were modified to incorporate a wheelchair accessible toilet stall in all student bathrooms (Fig. 2). In general, the stall modifications met or exceeded the UFAS minimum dimensions for accessible stalls. The *width* of the modified toilet stalls was 36" with 30.5" of clear space between the parallel grab bars. The inside *length* of the stalls was 71". Grab bars were installed at 33" AFF. The modification provided an accessible route to the toilet and a *clear space* outside of the accessible stall of 36" by 60". The toilets in the accessible stalls had been installed at a *height* of 19.5", with *flush controls* installed at 26" AFF.

The second grader's teacher reported that the accessible toilet stall was difficult for him to use independently, and he was uncomfortable with his female teacher assisting him in the bathroom, especially when other children were in the room. While the stall was large enough for his wheelchair, he lacked the strength and skill to maneuver the wheelchair into the stall with ease. Additionally, the grab bars were too high for him to use easily. The side reach required to grasp the grab bars added to the child's difficulty in using them (Photo 6). The fifth grader also had problems in using the accessible stall. This child needed to be able to hold onto something to maintain his balance while standing. The side walls of the stall were too far away from the center front of the toilet and grab bars were too low for this tall fifth grader for him to feel psychologically secure in leaning against the wall or grasping the grab bar. The bathroom that worked best for this child was a very small, staff toilet room where the doorway was 28" wide and the wall was less than six inches from the toilet on one side. The room worked well for this child because he was able to lean against the wall while standing in front of the toilet.

Urinals: Existing urinals were not modified.

Lavatories: An existing lavatory was replaced with an accessible fixture in each student bathroom (Fig. 2). The *height* of the accessible fixture was 28"AFF to the rim, with a *vertical clearance* of 25", *knee space height* of 22". Lever type faucet controls were used at a depth of 18" from the center of the faucet handle to the front rim of the lavatory. A force of 2.5 lbf was required to operate the faucet controls. No hot water was provided at any of the lavatories.

The distance from the front of the accessible lavatory bowl to the controls required the second grader to lean forward in his chair to reach the faucet handles. It was much easier for him to use the existing lavatories (Photos 7 - 9). The most serious problem in using the lavatories was a result of the slope of the bathroom floor in the lavatory area. As is commonly seen in older school bathrooms, the floor of this area was sloped to a central drain to facilitate hosing down the area. The slope made it difficult for the child in the wheelchair to approach the lavatory and hold his position at the front of the lavatory without locking the chair.

Bathtubs: There were no bathtubs at the site.

Showers: There were no showers at the site.

Drinking Fountains and Water Coolers: Most of the older free-standing water coolers had been replaced with low, wall hung water fountains. The *spout height* of the lowered fountain at the front entry was 32.5" AFF. *Vertical knee space* was 26" AFF with *knee space depth* of 7.35". *Toe space* was 10.5" high and 10" deep. The water fountain was not recessed, thus it could be approached from either side or the front.

The fifth grader who used Canadian crutches experienced some difficulty in using the water fountain (Photos 10-11). His height required that he bend down and over to reach the spout. This movement made it difficult for him to maintain his balance. He approached from the side and leaned against the water fountain for support.

The second grader in the wheelchair had a difficult time getting close enough to the water fountain (Photos 12-13). The foot rests on his wheelchair were too high for the available toe space. To get a drink, he had to lean forward in the chair to reach the spout.

Public Telephones: There were no public telephones at the site.

Restaurants and Cafeterias: The cafeteria had not been modified. However, staff reported than neither of the students experienced any difficulties except in reaching a carton of milk in the bottom of the chest type cooler used for milk storage.

Conclusions

Accessible Route and Ramps: The accessible route into the building at the front entry does not work well for children in wheelchairs. The sidewalk ramp is difficult to use independently and safely, ascending or descending. Even though the slope of the ramp (1:11.5) is close to the 1:12 minimum standard, there was no usable handrail. As a result, the child in the wheelchair lost control as he went down, and almost tipped over into the driveway at the bottom of the ramp. In addition, a landing at the bottom of the ramp might prevent a non-ambulatory child from entering the drive out of control. Finally, the second grader could not get all the way up the six foot long ramp by himself. The poor design and construction of the short ramp at the front door made independent access into the building difficult, if not impossible, for a child in a wheelchair. The route into the building presented fewer problems for an ambulatory child with balance and ambulation problems. Egress from the classrooms to the play space adjacent to each classroom on the main level was not wheelchair accessible.

Doors: The weight of the doors and the force required to open them presented greater difficulties for younger children and children with limited upper body strength than older and stronger children.

Classrooms: Three to four times as many children with orthopedic disabilities were expected in the upcoming school year. The problems created by room size and number of children will be magnified if more than one child in a wheelchair is assigned to the same room.

Toilets: The accessible toilet stall did not work well for either of the disabled children who participated in the site visit. For the younger child in the wheelchair, the stall was too narrow, approach difficult to maneuver and the grab bars were too high. For the older child who used crutches a small toilet room with the side wall close to the toilet, which he could lean on for balance, worked best.

Lavatories: The accessible lavatory was too deep for the younger child in the wheelchair to easily reach the controls. He was small enough that he could pull under an existing wall hung lavatory and reach its controls more easily. The slope of the floor made use of in any of the lavatories more difficult for this child.

Water Fountains: The wall-hung water fountains were difficult for both students to use. The younger child in the wheelchair was unable to approach close enough to get a drink without leaning far forward. The older child, who was tall, was forced to lean on the side of the fountain and bend over to reach the spout.

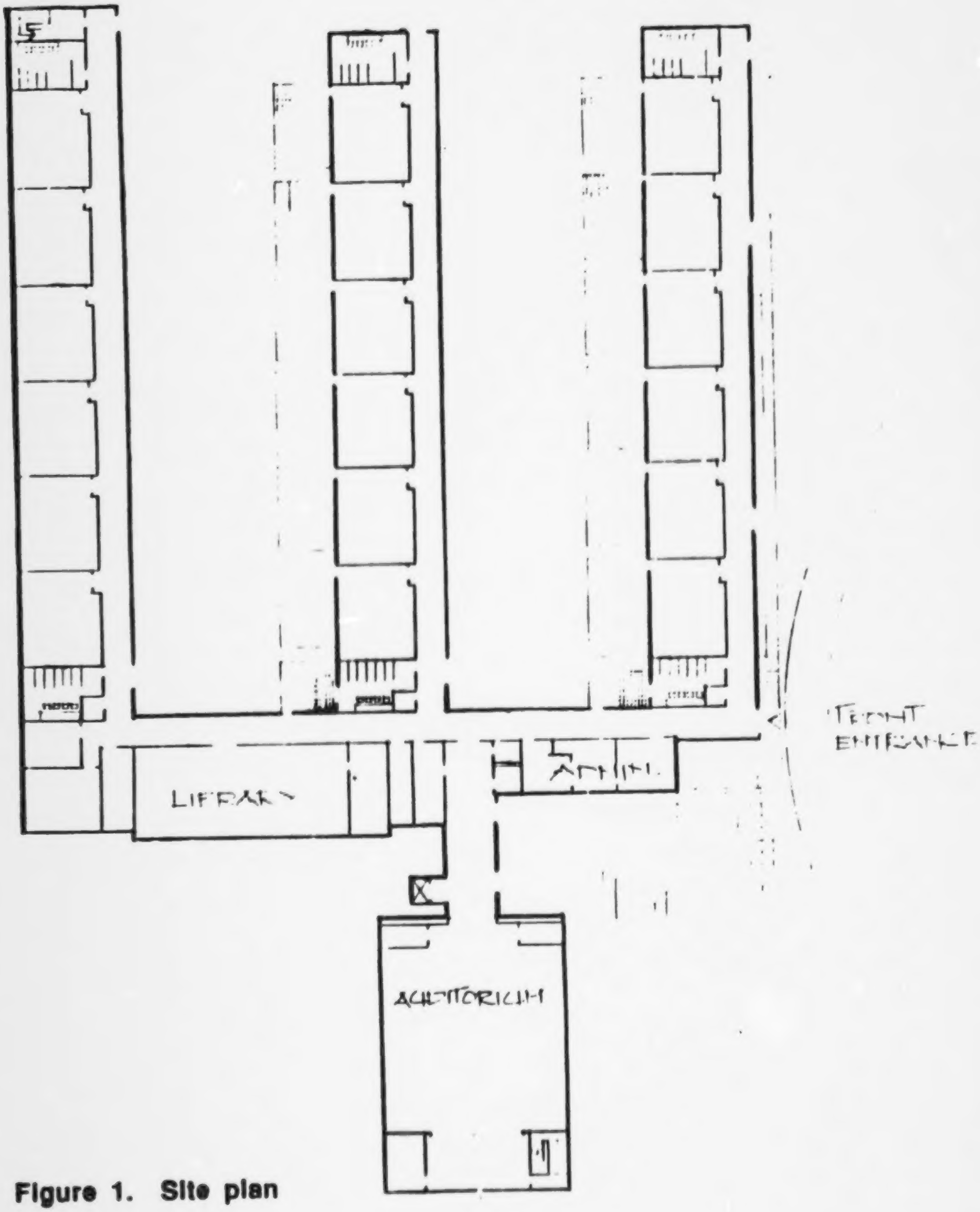
LIBRARY
ADMIN.
FRONT ENTRANCE
AUDITORIUM

Figure 1. Site plan

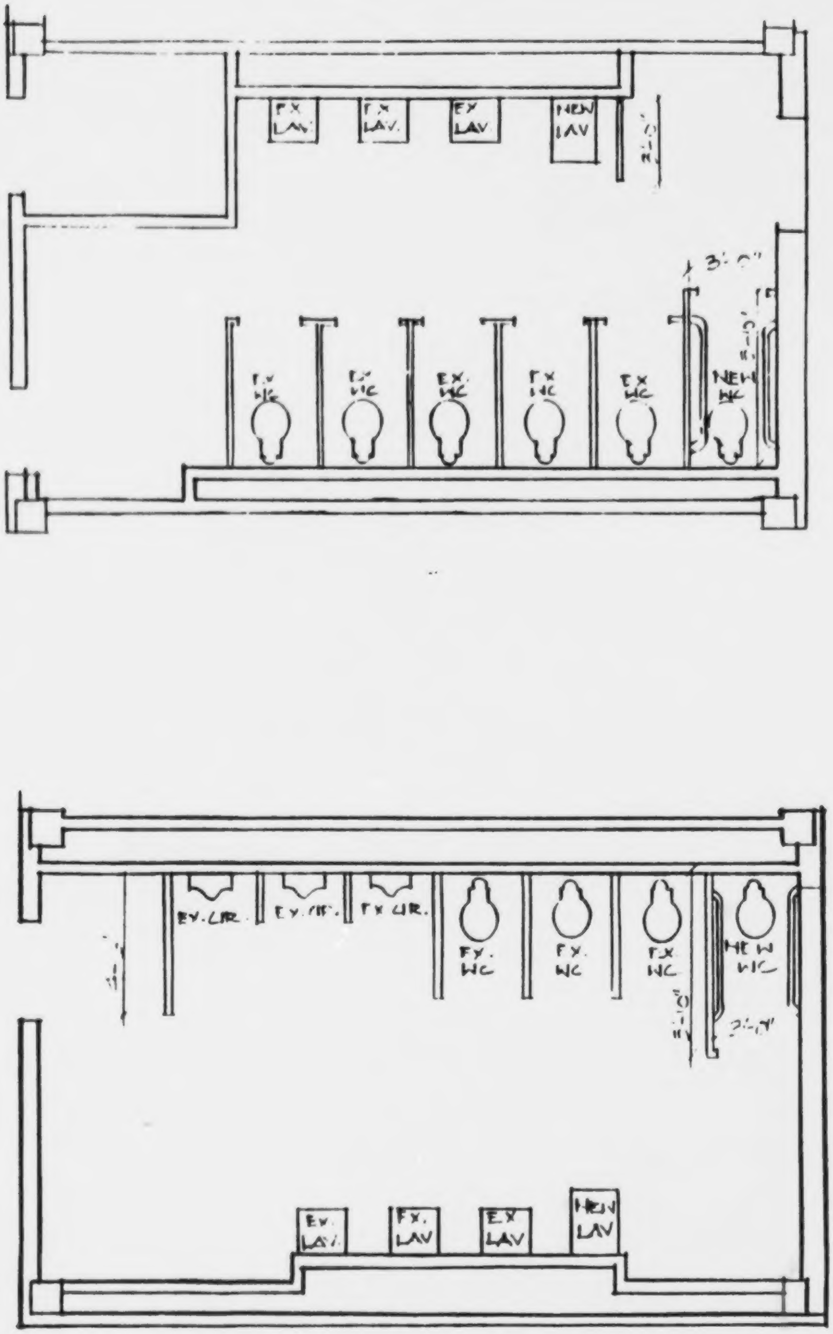
EX LAV
EX LAV
EX LAV
NEW LAV
EX WC
EX WC
EX WC
EX WC
EX WC
NEW WC
3'-0"
EX. UR.
EX. UR.
EX UR.
EX. WC
EX. WC
EX WC
NEW WC
2'-0"
EX. LAV
EX. LAV
EX LAV
NEW LAV

Figure 2. Toilet modification details

UNITED CEREBRAL PALSY DEVELOPMENTAL CENTER
FOR THE CAPE FEAR REGION
SPRING LAKE, NORTH CAROLINA

Site Description

The Developmental Center was designed by LSV Partnership, and opened in 1989. The director, Joanne Mackey, mentioned that they were "all quite pleased with its energy efficiency and maintainability".

Population Description: Twenty-six children under five years old were enrolled at UCPDC. All had cerebral palsy. One child was nonambulatory, two used walkers, one had a power wheelchair, and the rest were ambulatory.

Facilities: The small, one-story building was designed with a wide, double-loaded corridor that had an entrance/exit at each end (Figure 1, Photo 1). The entry was protected by a canopy not large enough to drive under (Photo 2). The Center had a large outdoor play area that was partially developed, but needed much more work to be properly functional (Photos 8 and 9). The children were housed in three classrooms, each of which was designed to accommodate approximately eight children and two adults.

The three classrooms were separated by bathrooms. The bathroom used by the youngest children contained a portable changing table. The wall adjoining the main corridor in the middle classroom was composed of four panels which could be removed in order to create a large activity space when combined with the OT/PT space on the other side of the main corridor (Photo 5). This space was used for events such as plays and performances.

A speech therapy room was located off of the main corridor opposite the classrooms. In addition to the therapist, the room could hold up to three children in wheelchairs. An infant stimulation room that contained five babies, ranging in age from nineteen months old up to three years, was situated next to the speech therapy room. All of the infants were functioning at the 0-3 month developmental level. The school's storage areas had a number of uses. One was used primarily for maintenance equipment, one was used to store equipment for the children, and one held an infrequently used, full-sized tub. Other sections of the building included an employee restroom, offices, and a small kitchen area for food preparation.

Data Collection Approach

The general Task 3 methodology and protocols were followed. An orientation meeting was held at the beginning of the one-day visit with the Center director, Joanne Mackey. A brief tour of the Center was made before the children started to arrive.

A focus group was held with eleven staff in the middle of the day, and two "demonstration" tours were taken with children. The first tour included one child who used an electric chair, whereas the other included two children who used walkers.

Findings

Accessible Route: Entry into the building was observed and videotaped for approximately 30 minutes at the beginning of the day (Photo 3). A very heavy rain fell for some of the time which provided an opportunity to observe the building's effectiveness under such conditions. The canopy did not provide adequate rain protection to children and adults as they went through the disembarkation process. As a result, several individuals got soaked during the one or two minutes it took to drop-off and unload passengers. An extension of the porch that would have fully covered arriving vehicles was not allowed by the fire marshal as this would have prevented fire fighting equipment from having access to the site. The wet conditions also caused the tiled surface at the entrance to become slippery.

The staff focus group expressed several comments such as "[they] are not user friendly to anyone on wheels," in reference to the *outdoor walkways* (Photo 6). In fact, one of the children leading a tour around the facility fell off the side of the walkway when her walker went off the edge (which was about six inches above grade). There was also a severe *cross slope* (between 1:12 and 1:6.8) on sections of the walkway because it had not been laid properly (Photo 6). Other staff looked positively on the walkway (which had been a voluntary community effort) because it was still better than none at all. However, it did raise the issue of maintaining reasonable standards of accessibility in voluntary building projects (see Table 1).

The research team noted the glare at each end of the main circulation spine, but none of the staff saw it as a problem.

Ramps: There were no ramps at this site.

Stairs: There were no stairs at this site.

Elevators: There were no elevators at this site.

Doors: The lobby entry doors *hardware* heights were 39"-41". The two single *doors in series* were difficult to handle by adults carrying a child, or, in some cases, carrying one child and holding the hand of another (sibling). The *push/pull force* required to operate the doors was 10.5 lb.-12.25 lb (see Table 6).

When both doors were fixed in an open position, entry was easier (Photo 4). Under these conditions ambulatory children could readily enter the school.

A semicircular drop-off area was provided at the main entrance of the school building. Staff mentioned that the bollards located to protect the loading zone from vehicles and the pillars holding up the porch got in the way of pedestrian circulation to the parking lot when a vehicle was parked with its lift down.

Staff remarked that the lever handles made the classroom doors easy to open. They agreed that the height of handles (39"-41") was good for everyone. Some teachers felt that children should learn to use "normal" doors rather than adapted doors that they will not find in everyday life. The child in the power chair who toured the facility with the research team, demonstrated how a door could be opened by using an article of clothing hanging from the door handle.

Curb Ramps: There were no curb ramps at this site.

Signage: No signage for use by children was installed at this site.

Parking and Passenger Loading Zones: : The designated handicapped diagonal parking spaces did not conform to the UFAS Standard. They not provided with adjacent access aisle which was part an accessible route, and were not equipped with a sign showing the symbol of accessibility unobscured by a parked vehicle. (see Photo 15).

Seating: There was no fixed auditorium seating.

Libraries and Media Center: There was no library at this site.

Classrooms and Instructional Areas: Generally, the lighting levels of up to 190 ft. candles in the classrooms was high (see Table 14).

Tables were adjustable and were adapted to the needs of each particular children in the classroom (Photo 11). *Table heights* ranged from 17.5"-23.5" and most teachers reported that they changed the heights of tables when required, even though it took more than one person to do it. Nonetheless, despite the availability of adjustable tables, a large proportion of activity took place on the floor (Photo 10).

Storage: Staff remarked that the cubby design was adapted from an earlier built-in model that was too high. One teacher indicated that most of the children in her class could reach their own coat hooks (34") and the lower (7.5") cubbies, but not the upper (33.75") ones (Photo 13). The child in the power chair who demonstrated the use of the cubby, had great difficulty, but was able to take his basket of personal possessions down from the higher cubby with a small amount of adult assistance (Photo 12).

Toilets, Urinals and Toilet Stalls: Staff mentioned that the *toilet seats* were too high (15.5") for children to use independently and that teachers had to pick the children up to transfer them (see Table 16; Photo 14). Nonetheless, even if the children could have transferred independently, the *grab bars,* which were not in compliance with UFAS, undoubtedly would have gotten in the way. It was also reported that children sometimes lost their balance and fell into the toilet, which made them feel insecure. The need for foot stools to stop children's feet dangling and to enable them to maintain stability was suggested by staff as a potential solution. Staff also reported that during the design programing for the building, there had been an extended discussion about toilet heights, whether they should have ones that were child-sized or ones that were at a standard height.

Lavatories, Bathtubs, and Showers: Staff reported that sinks were too high (24" to rim), and that children had a hard time reaching across the sink in order to operate the faucet controls. Older children were able to use the lavatories in the toilet room but did so by reaching the controls from the side(See Table 17; Photo 11).

Drinking Fountains and Water Coolers: There was none at this site.

Controls and Operating Mechanisms: Although staff discussed the possibility of having light switches at two levels so that children could, for example, turn off the lights at nap time,.the switches were at the standard height.

Public Telephones: None at this site.

Restaurants and Cafeterias: Trays are brought to children.

Conclusions

Accessible Route: There was a problem with the pathway outside the classrooms that had been improperly laid and had a cross slope of 1:6.8 at the most severe point. In addition, a convenient, safe entry into the school was restricted by the small canopy, the location of the canopy supports that blocked pedestrian traffic, and the manually operated entry doors.

Doors: Doors required too much force to open, particularly when adults were carrying children in their arms.

Classroom Tables: Adjustable height tables appeared to accommodate the needs of many of the students, although the floor is used for many activities. In addition, tables had to be extremely stable and sturdy to withstand the various ways in which students leaned on them for support.

Storage: Coat hooks at 34" seemed to be satisfactory, but cubbies at 33.75" were too high, despite being more than 2" lower than the ATBCB Recommendations of 36".

Toilets: Although they were lower than the UFAS (17"-19") requirements, the toilets were too high (15.5") for some of the children to use and keep their feet on the ground in order to maintain their balance.

Lavatories: Although these were standard sized lavatories, children had difficulty reaching to the back of the sink in order to operate the controls. A side approach worked better.

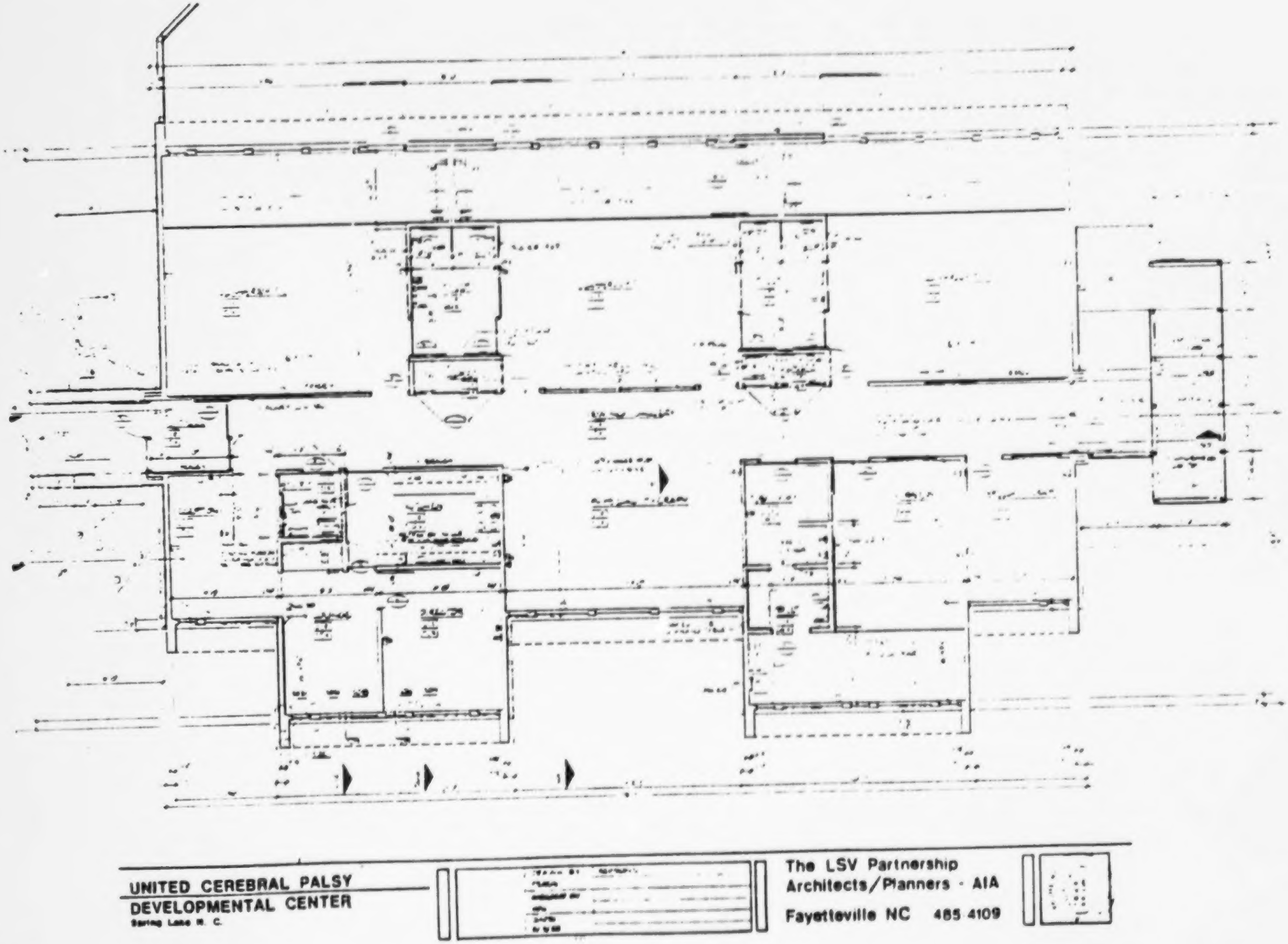
UNITED CEREBRAL PALSY
DEVELOPMENTAL CENTER
Spring Lake N. C.
The LSV Partnership
Architects/Planners - AIA
Fayetteville NC 485-4109

Figure 1: Floor Plan

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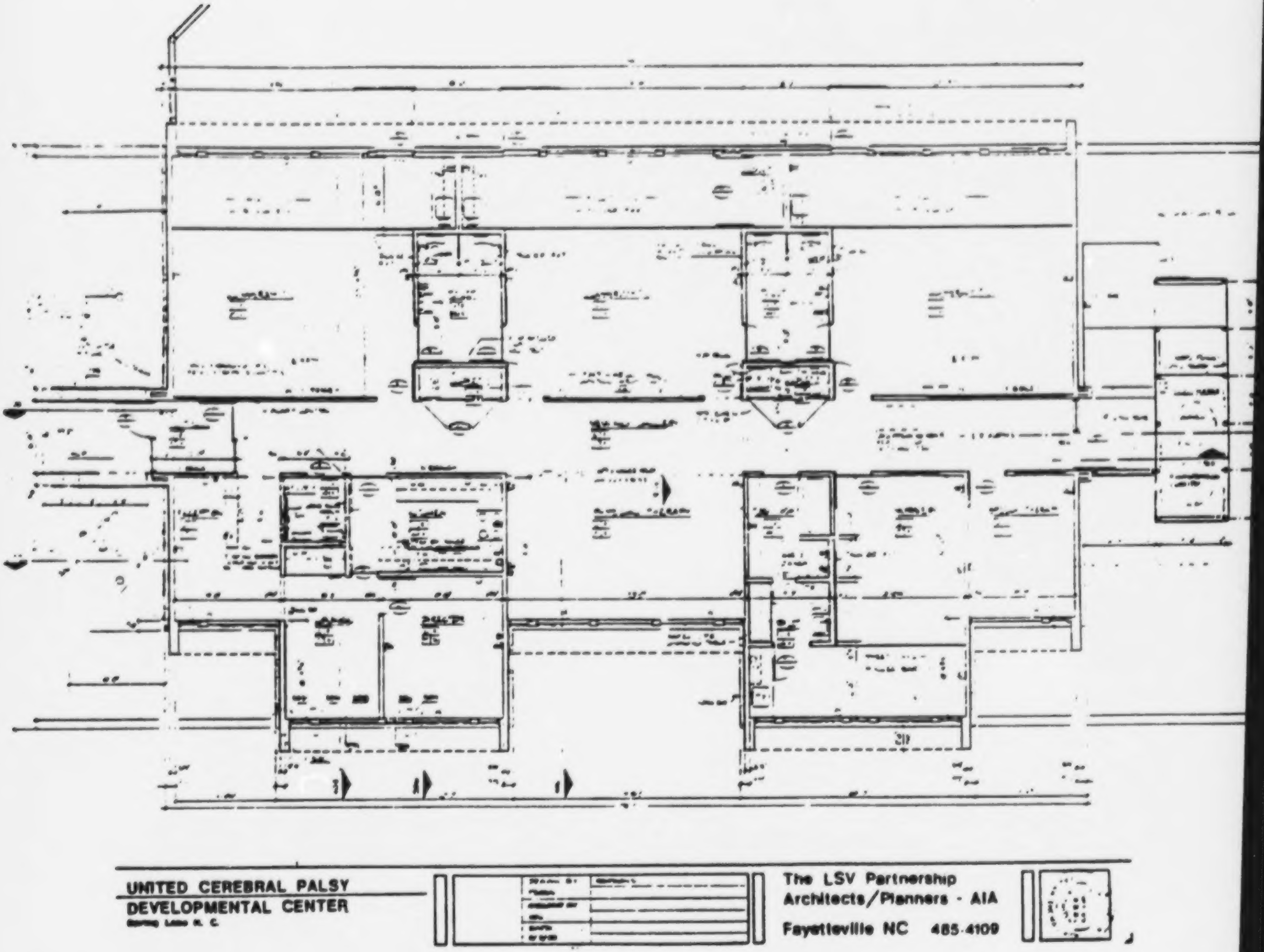
UNITED CEREBRAL PALSY
DEVELOPMENTAL CENTER
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Fayetteville NC 485-4109

Figure 1: Floor Plan

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WAKE COUNTY SCHOOLS
RALEIGH, NORTH CAROLINA

At West Pennsylvania School for Blind Children, many of the students had multiple disabilities that were so severe that they were not able to use any of the design features independently. As a consequence, it was important to identify at least one integrated school that had a group of disabled students who were sufficiently independent .

Much time was spent trying to locate a recently constructed middle or elementary school in North Carolina that was attended by a group of highly functioning students with orthopedic disabilities. Many telephone calls were made and many leads followed. Some of the schools were too old; and in other cases, the students had learning or emotional disabilities that did not impact their ability to use the various design features independently.

Due to a lack of success, a change in strategy was implemented. Rather than search for schools, the search focused on children. Working through parental networks, the Wake County Schools Lead Physical Therapist, Janet O'Neal was recommended. Ms. O'Neal organized a focus group meeting with a team of therapists. The therapists identified two middle school students and one elementary student that they felt would be appropriate as individual expert informants. Working through the Wake County Assistant Superintendent for Research, the parents were contacted for permission. The parents of one child refused; while the parents of the other two consented to have their children participate, but refused to let them be photographed. Nevertheless, it was felt that this was an excellent opportunity to work directly with students to document issues of accessibility in an integrated environment. One of the two students who participated attended East Wake County Middle School, and the other attended Vance Elementary School in Garner.

Data Collection Approach

The approach taken with the Wake County Schools was a substantially modified version of the Task 3 protocols. Instead of holding a focus group meeting with the school staff, a meeting with the Physical Therapist county team was held in order to get a more comprehensive picture of access issues in the new schools in the county as a whole. As only two children with disabilities were available, they were considered to be expert informants. As videotaping permission was not granted, data was gathered the "old fashioned way" - by observations of the design features in use while the simulations were occurring.

EAST WAKE MIDDLE SCHOOL

Site Description

East Wake Middle School was opened in 1989 and is located in an exurban, but rapidly suburbanizing area about 10 miles from the City of Raleigh.

Population Description: The school serves approximately 1,000 middle school students, two of whom are disabled, from East Wake County. The one disabled student who participated in the study was a fourteen year old boy who had cerebral palsy and used Canadian crutches. He was very willing to demonstrate use of the accessible features of the school.

Facilities: Buildings were constructed on two levels (Figure 1). The main building was located at a higher elevation than the surroundings. Two other wings were sited downhill, thus forming an open courtyard configuration around a steeply sloping interior lawn.

Findings

Accessible Route: Entry to the building was via a long ramp described below (Table1).

Ramps: A long, 1:12 ramp with 30' and 30'-2" segments separated by a landing was the main feature of the building entrance . It connected the bus drop-off location to the school entry doors (Table2, Photo 1). The PT focus group reported that students had some difficulty using this ramp. The student who participated in the study maintained that it was difficult to get up and down the ramp. A second ramp leading to the lower classroom wing of the school from the bus drop-off location was longer although less steep (Photo 2). This ramp was 128 feet long, without a landing and had a slope of 1:16. The student did not attempt to use this feature as ascending was too difficult and descending was too dangerous.

Stairs: The teachers at East Wake Middle School did not let the student who participated in the study use the stairs. Because he could not use the staircases, the spread out configuration of the school forced him to make longer, more circuitous trips from his classroom to the vocational education shop than others who used the stairs. Instead of going straight down the stairs close to the shop, he had to go via the central elevator then double back to the shop.

Elevator: The student was able to use the elevator without difficulty (call buttons at 42.5", car control buttons 39.5") (Table 5).

Doors: Entry to the school was via two 36" doors that required 7.5 and 10 pounds of force to open (Table 6). The student operated each with some difficulty by using a "blocking technique" with his crutches (Photo 3). In addition, he was able to use the classroom door with some difficulty. In violation of the fire codes, all of the fire doors were left open in the school because the automatic closers prevented the disabled students from getting through them and thus from getting to class. In an effort to solve the fire code problem, some of the doors had been equipped with magnetic catches (Photos 5 and 6) that would release the door in an emergency situation and enable the door to close. Finally, there was one bathroom door that required 17 lbs. of force to open that the informant had a great deal of difficulty in opening (Table 6). He maintained that the bathrooms without doors were easier to use (Photo 10).

Library/Media Center: The student could reach all the shelves (3" to 66.5") (Table13).

Classrooms: The student had no difficulty in using his classroom environment which had regular seats and desks (Table14).

Toilets, Urinals, and Toilet Stalls: Toilet height was a little higher (19.5") than the UFAS Standards (17"-19") (Table 16, Photo 11). Grab bars conformed to UFAS. However, the original toilet dispenser had been replaced with a new one (Photo 12) that did not conform (39" height instead of 26"; 36" from the rear wall, instead of 30"). The stall was 36" wide.

Lavatories: Lavatory height was 33" (under the UFAS maximum of 34", but in excess of the ATBCB recommendation of ≤ 30") (Table 17). Knee space height (26") was a little under the UFAS maximum (27").

Drinking Fountains: Two types of drinking fountains were provided (Table 18, Photo 8). The one used in most locations (Photo 4) was recessed. Its spout height (38") was higher than the UFAS Standard (36" maximum) and higher still compared to the ATBCB recommendation (30"). No problems were observed during the student use of either fountain.

Restaurants and Cafeterias: The serving line (Photo 7) was accessible to the student, although at one point a free-standing screen (that could have been moved to accommodate a student needing more space) constricted the space to 23" (minimum UFAS standards is 36") (Table 22).

VANCE ELEMENTARY SCHOOL

Site Description

Vance Elementary School was opened in 1987 and is located twelve miles due east of Raleigh near the town of Garner. The school is comprised of a new, one-story building that has a cruciform plan and an older gymnasium that is located about 200' from the main building. The buildings are located on a flat site and a large canopy structure provides a protected entrance to the school (Photo 1). The population of the school is just over 400 students. The student who participated as the expert subject was a ten-year old girl, who had cerebral palsy and used a quad cane. She had below knee braces and walked with difficulty, although her mobility had improved.

Findings

Most of the design features surveyed presented few problems for the student participant. She did not express any difficulty using her classroom, the library, the cafeteria, bathrooms or the recessed drinking fountains (Photos 7 and 8).

She did however, experience two major problems. First, the long (200') distance between the new school building and the gymnasium (Photo 2) taxed the limits of her stamina.

Second, she had difficulty using the entrance doors to the school. In order to operate the door from the inside, she had to lean over and push the door open with her head and shoulder, while at the same time grabbing the hinged stop on the bottom of the door to prop the door open. From the outside, she pulled the door while leaning over and placing her hand around the door in order to drop the stop down. In both cases she had to leave the door open otherwise it would close too quickly before she could pass though the doorway. In addition, all of the fire doors in the school were left permanently open (Photo 3).

Conclusions (East Wake and Vance Elementary Schools).

The simulated actions of the expert subjects clearly identified several design features that create difficulties for disabled children.

Travel Distance: A major issue for both children was the sheer distance involved in moving between classrooms and destinations for other instructional activities (e.g., shop and gym) located in other buildings.

Ramps: Difficulties with travel distance were greatly exacerbated by long, steep ramps, as at East Wake.

Doors: The most problematic feature in both schools, by far, were the doors. This was a result not only of the amount of force required to open and hold the door, but also the time it took to get through the doorway. Both children demonstrated remarkable inventiveness and skill in dealing with this issue in his or her own particular way.

Of particular concern is the issue of fire doors that are left permanently open (in violation of the fire code) because they are too heavy for children with disabilities to open. The magnetic catches employed on some of the East Wake Middle School doors that release the door in an emergency seem to be a good solution to this problem.

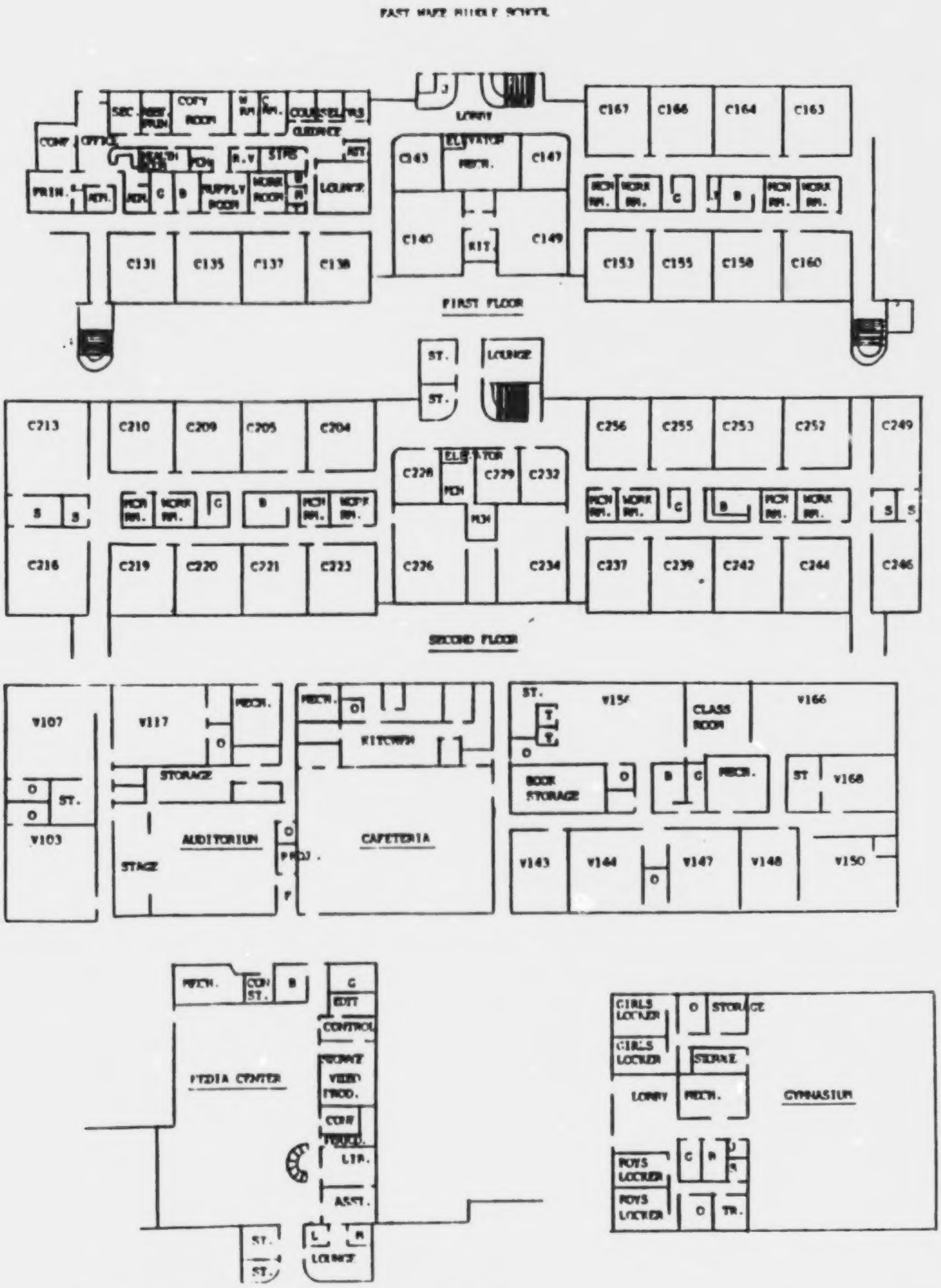
EAST WAKE MIDDLE SCHOOL
LOBBY
ELEVATOR
MECH.
SEC
COPY ROOM
COUNSELORS
GUIDANCE
CONF.
OFFICE
HEALTH ROOM
PRIN.
SUPPLY ROOM
WORK ROOM
LOUNGE
C131
C135
C137
C138
C143
C147
C140
C149
C167
C166
C164
C163
C153
C155
C158
C160
FIRST FLOOR
ST.
LOUNGE
C213
C210
C209
C205
C204
C256
C255
C253
C252
C249
C228
C229
C232
C216
C219
C220
C221
C223
C226
C234
C237
C239
C242
C244
C246
SECOND FLOOR
V107
V117
MECH.
KITCHEN
V156
CLASS ROOM
V166
STORAGE
BOOK STORAGE
V168
V103
AUDITORIUM
STAGE
PROJ.
CAFETERIA
V143
V144
V147
V148
V150
MECH.
CON ST.
EDIT
CONTROL
VIDEO PROD.
MEDIA CENTER
LIB.
ASST.
LOUNGE
GIRLS LOCKER
STORAGE
LOBBY
GYMNASIUM
BOYS LOCKER

Figure 1: Floor Plan of East Wake Middle School

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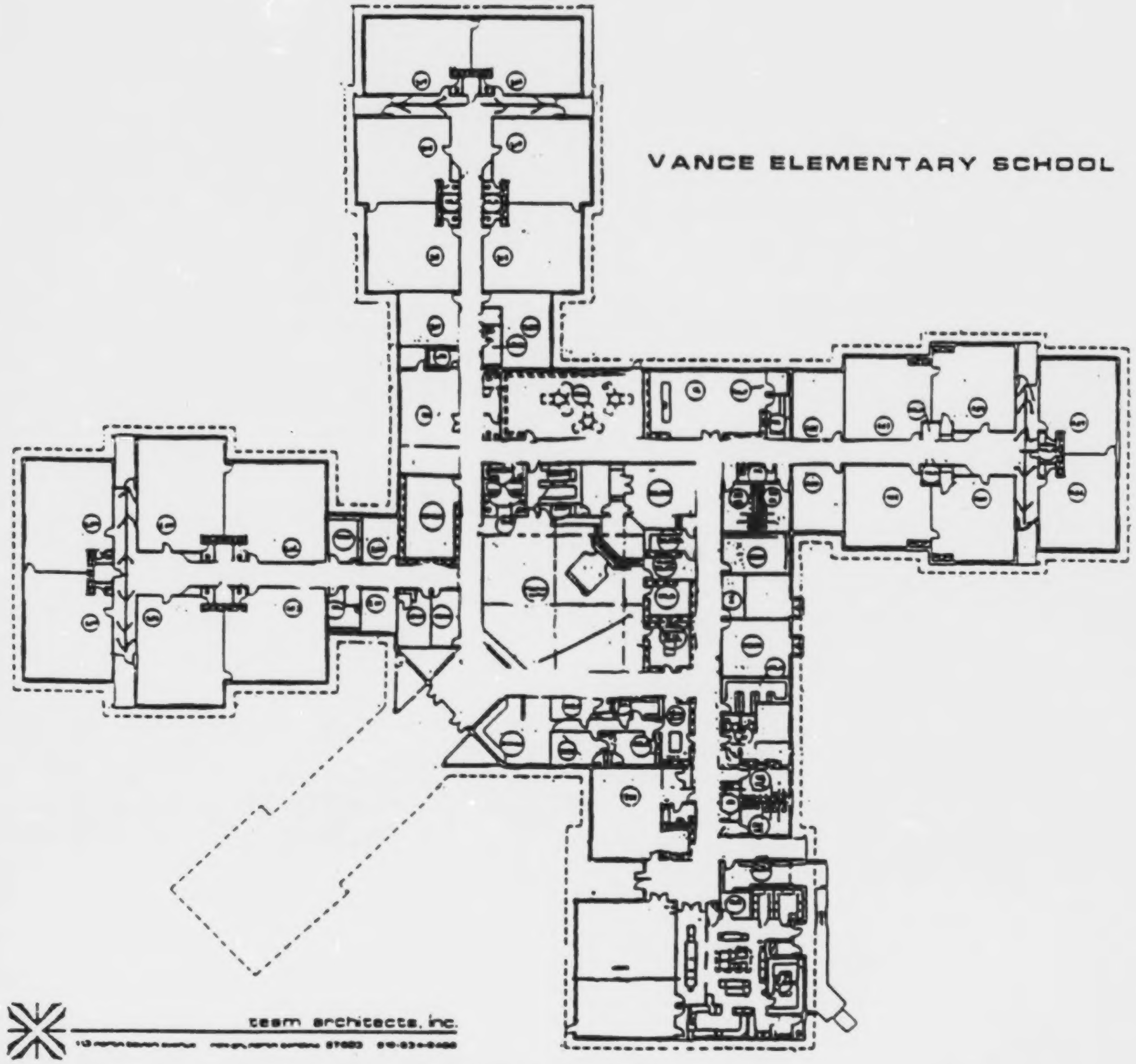
VANCE ELEMENTARY SCHOOL
team architects, inc.

Figure 2: **Floor Plan of Vance Elementary School**

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WEST PENNSYLVANIA SCHOOL FOR BLIND CHILDREN
PITTSBURGH, PENNSYLVANIA

Founded in 1887, the West Pennsylvania School for Blind Children (WPSBC) is one of four chartered schools in the Commonwealth of Pennsylvania. The charter is recognized by the General Assembly and the State Department of Education. It is the third largest residential school in the country.

Site Description

The school is located approximately 2 1/2 miles east of downtown Pittsburgh in the Oakland district of the city, in the same vicinity as the University of Pittsburgh and Carnegie Mellon University.

The school serves 180 children, aged two through twenty-one years old, from western Pennsylvania. Each class has eight students per room.

Population Description: For the past twenty years the school has accepted multiply disabled students. All students are legally or totally blind, and most have moderate to severe multiple disabilities. The majority of the students is residential, living at the school five days a week. The school is in session 180 days of the year, and supplemental summer programing is offered.

The type and severity of disabilities represented in the student population up to the age of fourteen included 22 who were totally blind and 105 who were legally blind. Seven students had profound hearing loss, and seven had mild to moderate hearing loss. Seventy-eight students were unable to walk and 14 walked with difficulty. Twenty-nine students were unable to use hands and arms, and 48 had limited use of hands and arms.

Facilities: The original school consisted of seven separate buildings. In September 1988, these were combined into a single contiguous facility containing some fully renovated buildings and substantial new construction on four levels (Figures 1-4). The residential buildings were completely renovated and new wings containing classrooms, a swimming pool, a multipurpose room and other specialized facilities were added. An entrance canopy and a spacious entrance with power sliding doors were also added/renovated (Photo 5). The design for the renovation and new construction was executed by Sylvester Damianos, former president of the American Institute of Architects.

Data Collection Approach

The Task 3 methodology and protocols were followed. A briefing meeting was held at the beginning of Day 1 with the director, Dr. Janet Simon and the Chief Administrative Officer, Curt Ellenburg. This was followed by a tour of the school. At this point it was decided that there were no accessible features used frequently enough to justify recording by video as naturally occurring events. The one exception was the sequence of arrival behaviors occurring at the beginning of in the day. This was done on Day 2.

Execution of the study protocols focused on the new buildings, as directed by the project scope of work. Spaces included classrooms, hallways/circulation routes, elevators, staircases, bathrooms, and residential bedrooms. The pool was also included.

Focus group meetings were held with the school staff and senior students. These students, who were older than the ages targeted by the study, participated because the Director felt that the older students, most of whom had been at the school since their preschool years, would have critical comments and perceptions to share. This proved to be the case, with respect to the impact of specific features for students with vision disabilities. However, as all these students were ambulatory, there was no opportunity to systematically simulate interaction with accessible features by children using wheelchairs or other assistive devices, although a proportion of these data were gathered through informal observations of younger students.

Findings

Accessible Route: Entry into the building (Photos 1 and 2) was observed for twenty-five minutes at the beginning of the school day on Day 2. One problem observed (which was commented on by two of the vehicle drivers) was the wait up to twenty minutes that the majority of the vehicles had to make before dropping off the children. At one point, fourteen vehicles were lined up waiting to drop off under the canopy. Because of the congestion, the ramp from the car parking area was completely blocked for fifteen minutes (Photo 2).

Once the drop off at the canopy had occurred, entry into the school itself was accomplished with ease. Nonambulatory children and those with walking difficulties were assisted by adults (Photo 6) through two serial sets of double 36" power sliding doors into a "Children's Waiting Area" (Table 1, Figure 2, Photo 6). From here, most were pushed or pulled to their classrooms via the double-ramped "corridor" (Figure 20, Photo 7) leading to the elevators (see Ramps below for further description).

No ambulatory children were observed using canes inside the buildings, although they were instructed in cane technique in the neighborhood around the school. A six inch wide *"trailing board"* (28 1/2" from the floor to the bottom) was mounted on the wall throughout the new and renovated buildings. To help users tactually recognize the device, it was designed with two half-round mouldings giving it a consistent cross section. This device was observed in use during the morning arrival by ambulatory, severely or completely sight disabled students as a means of wayfinding (Photo 18). Students reported that at locations when the trailing board became discontinuous (e.g., at protruding half columns), it caused apprehension for some children.

Because a wall-mounted board was used for trailing rather than canes, some wall-mounted *protruding objects* were a problem. The student focus group pointed out objects protruding from the walls of the corridors in both the renovated and new buildings. These included fire hydrants, wall-mounted telephones, drinking fountains, fire alarms, electrical switches, circuit-breaker boxes, and drinking fountains (Table 1, Photo 13). In many cases, these protruding objects met current requirements. In the new classroom building, students commented on the structural half-columns that protruded from the walls opposite the classrooms that interrupted trailing behavior (Photo 11).

Partially sighted children were largely able to cope with these interruptions to smooth trailing. For totally blind children, the situation was different. Several of these students spoke from personal experience or mentioned incidents of other students who had hurt themselves by hitting these objects as they moved around. Even objects protruding two inches or so could cause a grazed forearm or bruised finger.

Ramps: Three ramps in the school were identified by the staff focus group as being problematic. The first two were the long ramps referred to above at each end of the corridor connecting the Children's Waiting Area to the elevators (Table 2, Figure 2, Photo 7). Teachers mentioned that their *length* (32') and /or *slope* (1:16, 1:19) were problems, even though the slopes were considerably shallower than the UFAS standard (1:12). They reported that it was easy to lose control of wheelchairs there, especially when trying to maneuver two wheelchairs at once (as was often the case). Because of the slip hazard caused by water from wet feet in wet weather on the highly-polished surface (non-complying) of the ramp, a strip of carpet had been added to each ramp, taped down with duct tape to stop it "riding" to the bottom of each ramp. The third and worst ramp (according to staff) was the one on the third floor leading from the main building to the annex (Figure 3, Photo 10). "Sometimes I have to back down it when I'm moving a child in a wheelchair," one of the staff observed. This ramp had a slope of 1:8.

Staff complained about all the ramps in the school with respect to adults being required to maneuver two wheelchairs up and down them. This included the one by the art gallery (Photo 9, 1:13 slope), although all except the worst one (described above) conformed to UFAS (between 1:13 and 1:19 slope). No ambulatory children were observed having difficulty using the ramps. Ramp *railing heights* varied between 32"-34" AFF.

Stairs: The set of stairs adjacent to the main elevators at WPSBC was problematic (Table 4, Photo 15). These stairs were being used by some of the older, ambulatory children. The *illumination level* (7.5-8 ft. candles) was very low. The hazard presented by the low level of illumination was accentuated by the lack of a high contrast nosing treatment. Staff commented that it was difficult to see children on the stair because of the low illumination, and the monochromatic color scheme. Furthermore, there was a severe hazard presented by a valve on a service pipe riser protruding into the landing immediately beyond the entry door.

The 12" *tactile warning* strip at the head of the flight of stairs from the new wing connecting to the entrance lobby was commented upon by the student focus group (Photo 12). They suggested that such a warning surface should be wider and 36"-48" back from the first nosing. They also commented that the high color contrast nosings made it easier for partially sighted students to negotiate the stairs.

Stair railings (like ramp railings) at WPSBC tended to be set higher (34.5" above nosing) than the UFAS Standard (30"-34" above nosing) and a lot higher than the Florida recommendations (26"-28" above nosing).

Elevators: Part of the staff focus group discussion addressed the *height* and *location* of buttons in the elevator car (Table 5, Photo 14). A general complaint was that the buttons were out of reach of children under eleven or twelve, even those with good reach. In fact, they were higher (43" to the center of the panel) than any of the recommended standards (UFAS 42", ATBCB Recommendations 34", and Florida 34"-36", Table 5). When asked if two sets of buttons (a lower set on the side of the car) would be more effective, the reactions were mixed. Some said it would help, others said it was too complicated.

Even though *door delay* (8 seconds) was a little less than the Florida recommendation (10 Seconds), no one commented that it was too fast. At 8 seconds it was slower than the UFAS Standard of 3 seconds; this allowed a single adult to maneuver two wheelchairs simultaneously in or out of the elevator.

Doors: Because of the physical limitations, very few of the students at WPSBC were able to operate the doors. Staff commented that some children could not turn the (round) door knobs, even though they could push the door open. Staff admitted they had had little experience with either strongly textured (to improve grip), lever-type handles or other accessible hardware (Table 6).

Curb Ramps: None were encountered at WPSBC.

Signage: Although informational signs at the school classrooms were attractively designed and presented, consideration for the needs of children with sight disabilities was not made in terms of providing large raised letters or Braille alternatives (Table 9). Furthermore, the measured display *height* (59" to the panel center) was considerably more than the ATBCB Recommendation of 40" maximum.

Drop-off and Loading Zones: The long line of waiting vehicles at the beginning of the day was noted above. This caused frustration for some of the drivers (Table 11).

Seating: This measure did not apply, as the WPSBC did not have an auditorium. It had a large multi-functional room, but there were no fixed seats or tables in it (Table 12).

Library/Media Center: There was a small library at WPSBC but it was not set up to be accessible to students (staff use only) (Table 13).

Classrooms and Instructional Areas: *Table heights* were set to meet the needs of various students, many of whom worked in adapted seats with individual work boards (Table 14, Photos 20 and 21). Most tables were round with adequate *knee space*.

Classroom *lighting levels* (39-49 ft. candles) were lower than the North Carolina Standard (60-70 ft. candles). Staff mentioned the need for variable intensity light. Some children needed a lot, while others were photophobic.

The major classroom issue related to the noncode issue of lack of sufficient *storage*. Ideally, teachers wanted space to store wheelchairs in the classrooms instead of in a "wheelchair park" at the far end of the classroom corridor (Photo 8). Furthermore, much classroom space was taken up with bulky special equipment which cut down on the amount of usable floor space.

Storage: Classroom *clothing hooks* were higher (56.5" and 38.5") than the ATBCB Recommendation of 36" (Table 15). Staff mentioned that coat racks and some *cubbies* were too high, although the lower ones (3" and 9.5") were usable by five-year-olds. Staff also commented that the bathroom cubbies were all identical (i.e. lacked differentiation to give individual user identity) and were out of reach of a large proportion of children.

Toilets, Urinals, and Toilet Stalls: *Toilet* and *grab bar heights* conformed to UFAS (17"-19", 33"-36" respectively), whereas *flush controls* were lower (25.5"-28") than the UFAS maximum of 44" and closer to the ATBCB Recommendation of 32" maximum height (Table 16).

Stall widths varied between 38.25" and 48", compared to the UFAS required width of 60". *Stall lengths* varied between 30" & 71", compared to the UFAS standard of 56" or 59".

The staff focus group commented that the toilets between the classrooms (Photo 22) were too high (19"). If they were lower, more children would be able to transfer on their own. Most stood up first or were transferred by their teacher.

Toilet paper dispensers were set high (22"-24.5") compared to the 19" minimum in all the existing standards. Distances from the wall (24"-36") just overlapped with the ATBCB Recommendation of 18"-24". The large majority of stalls conformed to the existing standards.

Lavatories, Bathtubs, and Showers: Some of the physical measures conformed closely to the UFAS Standards (Table 17). Others were closer to the smaller measures of the ATBCB's Recommendations. Unfortunately, opportunities were not available to evaluate the dimensional variations with children who could use the accessible features independently

Lavatory height varied from 32"-38.5", in some cases in excess of the UFAS Standard of 34" maximum, and the ATBCB's Recommendations.

Several staff focus group comments were made regarding the bathroom facilities between classrooms. The general feeling was that they were sized more for adults (in accord with UFAS). A request was made for adjustable height *sinks*. Many contained adaptations for ambulatory students (Photo 23). Other staff commented that the *knee heights* (28.5") were good for wheelchair users but users could not reach the *controls* at the back of the sink.

Staff commented that the senior instructional wing had better, well thought-out bathrooms that were designed with staff input (Photos 28 and 29).

Knee space height varied from 25"-29", compared to the UFAS standard of 27", and ATBCB Recommendation of 24". *Toe space* presented a similarly picture of lack of agreement with the various standards.

Comments were made by the staff focus group regarding the difficulties they had when bathing students (Photo 24). Because students had to be transferred into and out of the tub sideways, staff put themselves in danger of injuring their backs. Also the *clear space* beside the tubs was too narrow (29", whereas UFAS specifies 30"-48"). To overcome this, staff suggested leaving the end of the tub open to facilitate an end-on rather than a sideways lift (Photo 25). It would help a two-person lift also.

The students' focus group had specific comments about the form of the soap dispenser and its unsatisfactory location in the residential bathrooms (Photo 25). They wanted soap dispensers without a projecting plunger that caused grazes and bruises as students hit it inadvertently. Further, they suggested placing other dispensers at a high level on the same wall as each shower, within easy reach of the user (Photo 26).

Drinking Fountains: Spout height (35.5") conformed closely to UFAS (36") but was much higher than the ATBCB'S Recommendation of 30" (Table 18). Similar differences with respect to vertical knee space applied to actual measures (26"-29") compared to minimum UFAS 27" for adults, or 24" for children. Again, as with lavatories, the opportunity to test these dimensions with other students was not possible (Photos 16 and 17).

Controls and Operating Mechanisms: The staff focus group commented that most of the light switches (in the classrooms) are too high (21.5"-44") for small children who have to use extenders to operate them .

Public Telephones: The one public telephone at WPSBC was mounted at 26.5" AFF (Table 21).

Restaurants and Cafeterias: At WPSBC food trays were brought to each child prepared according to his/her dietary requirements. The student focus group commented that there were too many columns in the cafeteria space, that no warning was provided and they were easy to walk into and get hurt.

Additional Considerations: Of serious concern to the staff was the lack of overall *color and contrast* in the school. They were all surprised to find this when they first moved in. A general desire was expressed to have more color in the classroom and residential spaces. These issues were reiterated by the student focus group. "Everything's white and grey. The third floor is all white, you get lost. The hall's much too bright - well, not too bright, but the floor needs to be a different color. The color of the wall can throw you off", (partially-sighted student).

Added to this characteristic, there was a serious problem of *glare* in some of the corridor spaces partly resulting from the pale, highly-polished, reflective flooring next to large glazed areas transmitting natural daylight (Photo 11).

Although not covered by existing standards, staff mentioned that the space around the *changing tables* in the classroom bathrooms was too tight (Photo 22), especially for a two-person lift. One staff reported that she sometimes had to lift a child across the heads of two others in wheelchairs.

Conclusions

There were several issues both positive and negative that drew staff comment, and/or that were backed up by field observations by the research team.

Entry: The power sliding doors on the vesibule at WPSBC were a major positive feature that facilitated the moving entry to the school enormously.

Ramps: These features seem often to be problematic, especially for staff trying to push or pull two wheelchairs at a time.

Staircase: The low illumination and lack of visual differentiation in the staircase was a major issue.

Lavatories: What is the most appropriate rim height and knee clearance space? Is the only solution to have adjustable height lavatories?

Bathtubs: Consideration should be given to providing a standard for an open-ended bathtub to facilitate transfer by an adult(s).

Visual Character (Noncode): The lack of differentiation in the pale color scheme, combined with the glare and reflections from highly polished floor surfaces was a major issue for some of the partly-sighted students.

Trailing (Noncode): The "trailing board" used throughout the new building was a very helpful device for blind students. Conversely, the many projecting features, especially in the old building, were a "disadvantage" (term used by one member of the student focus group).

Changing Tables (Noncode): Standards are required for changing tables in bathrooms.

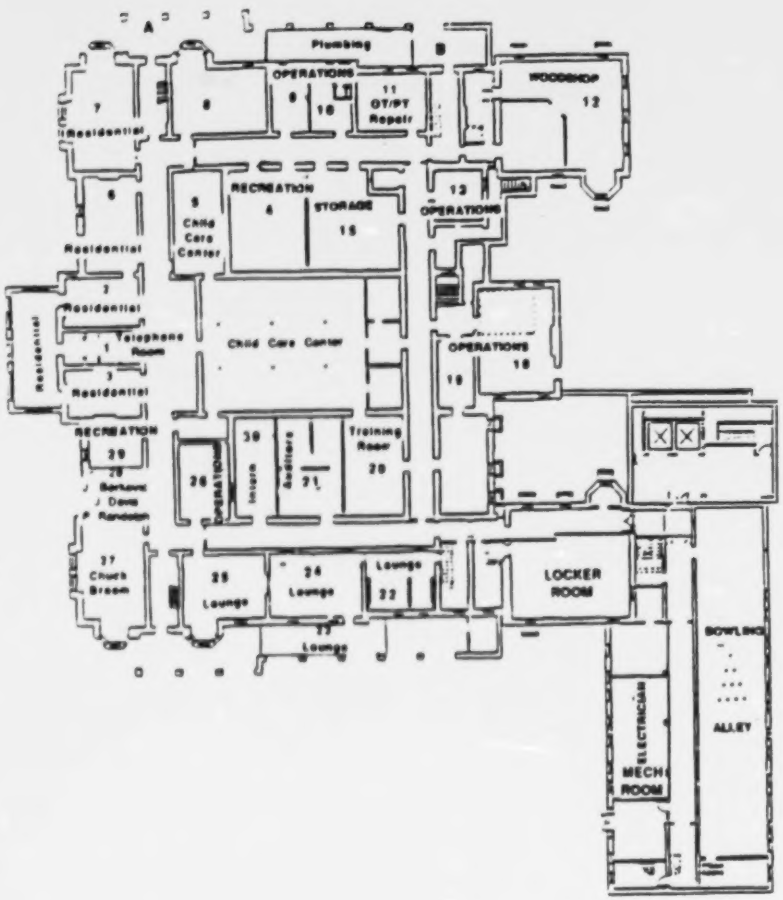
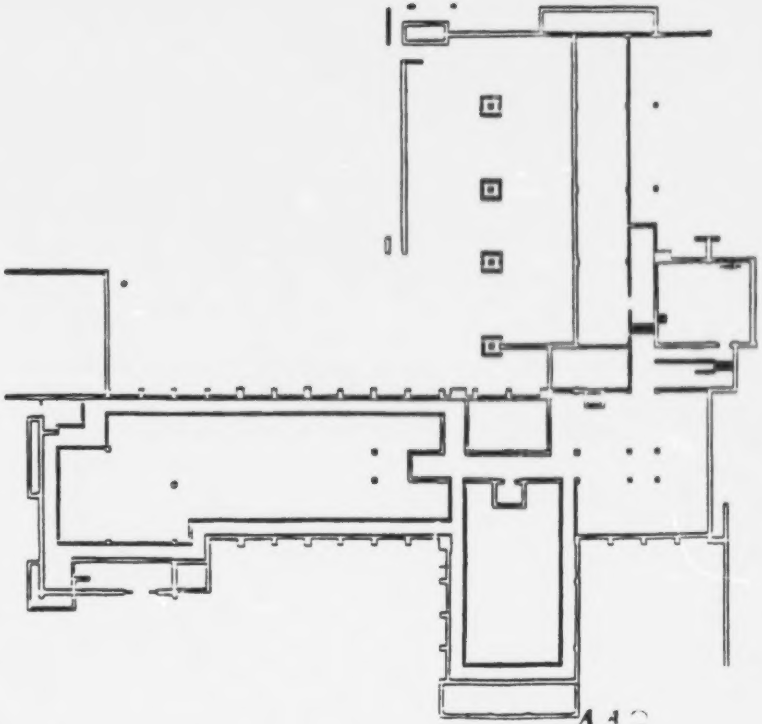

A
B
Plumbing
OPERATIONS
7
Residential
8
9
10
11
OT/PT
Repair
WOODSHOP
12
6
Residential
5
Child
Care
Center
RECREATION
4
STORAGE
15
13
OPERATIONS
2
Residential
Residential
1
Telephone
Room
3
Residential
Child Care Center
OPERATIONS
18
19
RECREATION
29
28
J Berkovic
J Davis
P Randolph
26
OPERATIONS
30
Interns
Auditors
21
Training
Room
20
27
Chuck
Broom
25
Lounge
24
Lounge
Lounge
22
23
Lounge
LOCKER
ROOM
BOWLING
ALLEY
ELECTRICIAN
MECH
ROOM

Figure 1: Basement Plan

WESTERN PENNSYLVANIA SCHOOL FOR BLIND CHILDREN

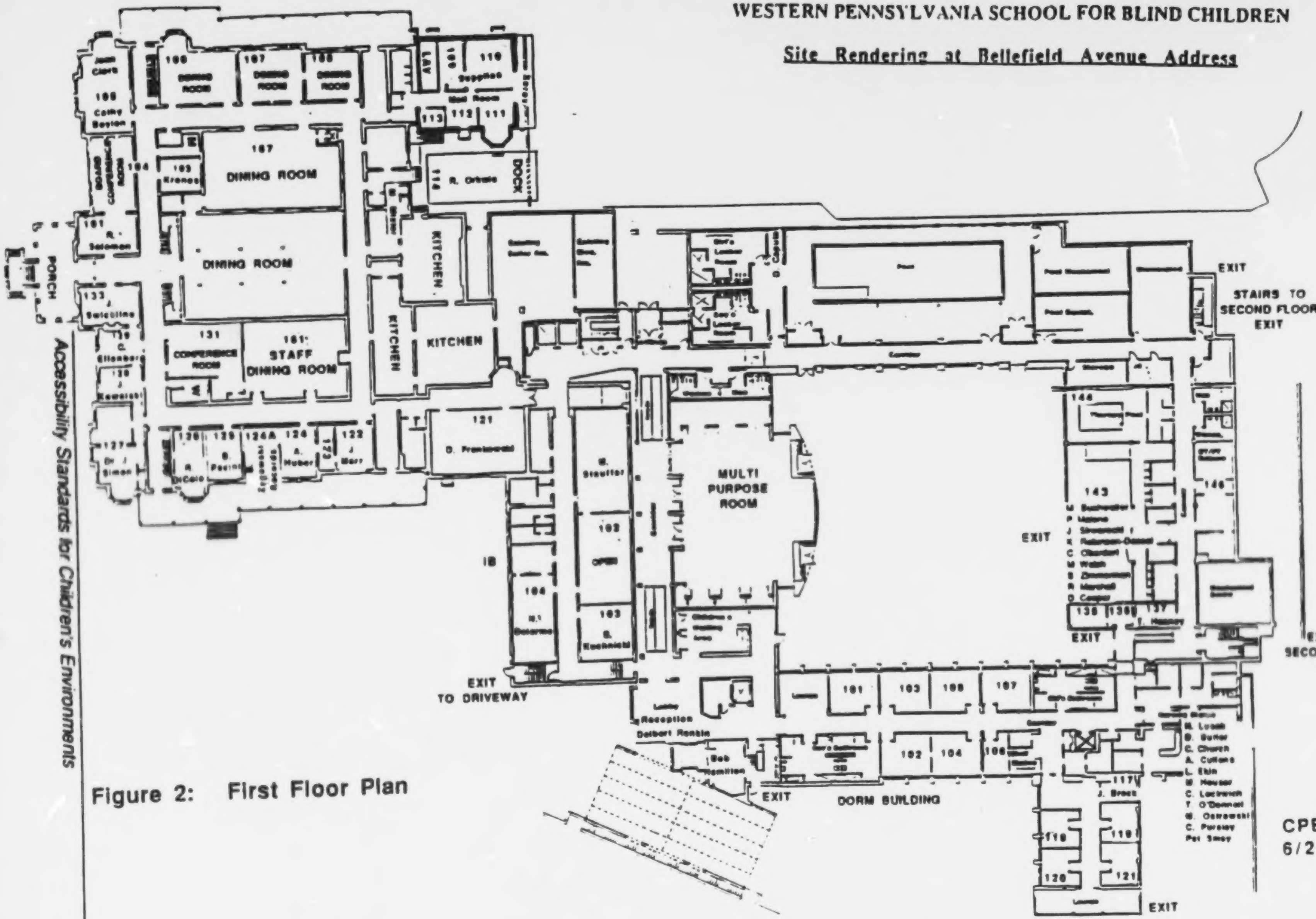
Site Rendering at Bellefield Avenue Address



CPE/lk

WESTERN PENNSYLVANIA SCHOOL FOR BLIND CHILDREN

Site Rendering at Bellefield Avenue Address



DINING ROOM
DINING ROOM
STAFF DINING ROOM
CONFERENCE ROOM
KITCHEN
KITCHEN
KITCHEN
LAV
DOCK
PORCH
MULTI PURPOSE ROOM
EXIT
STAIRS TO SECOND FLOOR EXIT
EXIT
EXIT
EXIT TO SECOND FLOOR EXIT
EXIT TO DRIVEWAY
EXIT
DORM BUILDING
EXIT
OPEN
Lobby Reception
Delbert Rensie
Bob Hamilton
143
121
131
167
101
102
103
104
105
106
107
117
118
119
120
121
136
137
144
146
CPE/jk 6/22/90

Figure 2: First Floor Plan

WESTERN PENNSYLVANIA SCHOOL FOR BLIND CHILDREN

Site Rendering at Bellefield Avenue Address

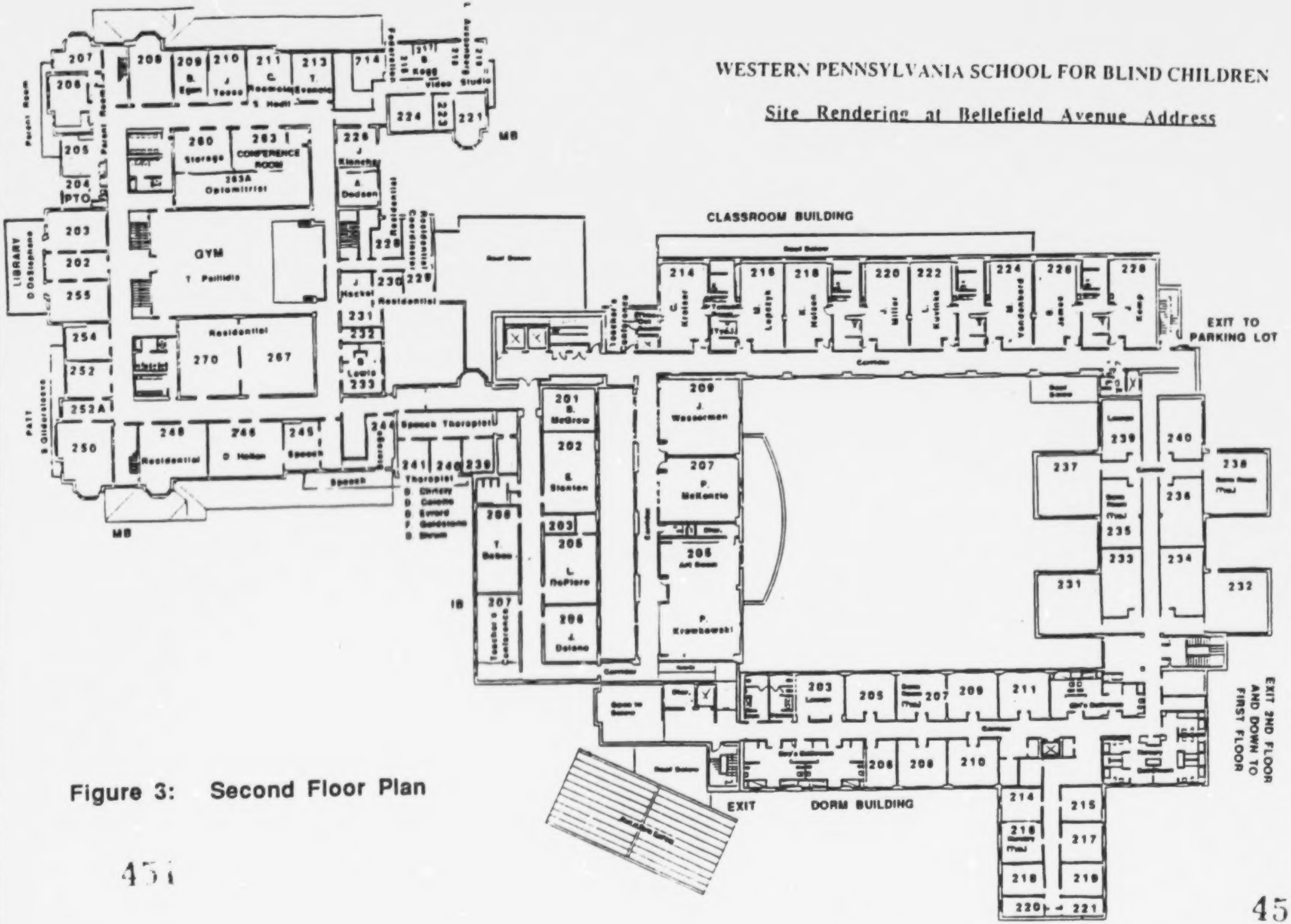

CLASSROOM BUILDING
DORM BUILDING
GYM
LIBRARY
Storage
CONFERENCE ROOM
Optometrist
Residential
Speech Therapist
Speech
Therapist
Teacher's Conference
Corridor
EXIT TO PARKING LOT
EXIT 2ND FLOOR AND DOWN TO FIRST FLOOR
EXIT
MB
IB
PTO
Parent Room
Video
Studio
Art Room
207
208
209
210
211
213
214
216
218
220
222
224
226
228
230
231
232
233
234
235
236
237
238
239
240
241
244
245
246
248
250
252
252A
254
255
260
263
263A
267
270
201
202
203
204
205
206
215
217
219
221
223

Figure 3: Second Floor Plan

451

CPE/jk
6/22/90

WESTERN PENNSYLVANIA SCHOOL FOR BLIND CHILDREN

Site Rendering at Bellefield Avenue Address

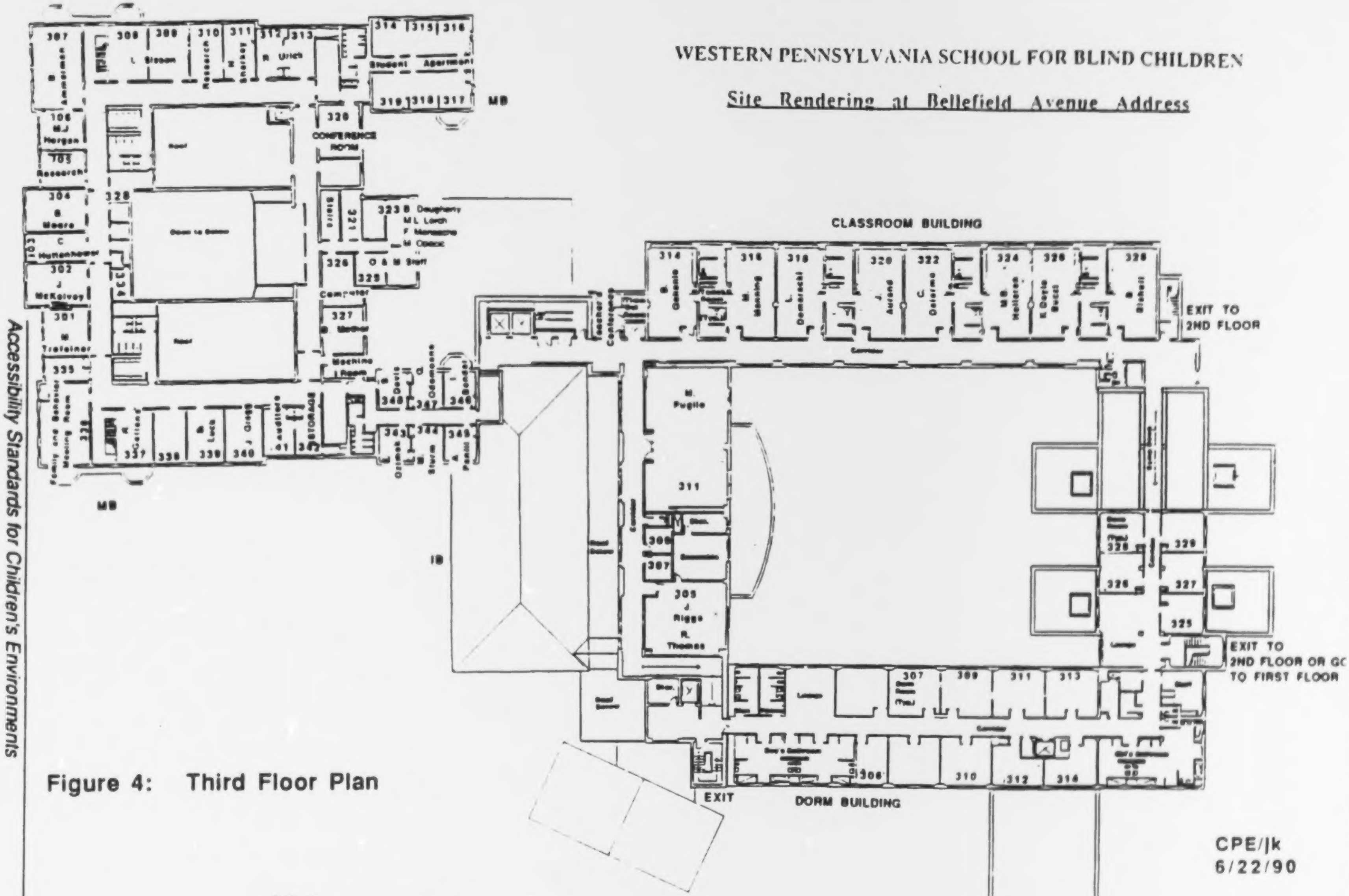

307
308
309
310
311
312
313
314
315
316
L. Sisson
R. Ulrich
Research
Student Apartment
319
318
317
MB
320
CONFERENCE ROOM
306
305
Research
304
303
302
301
335
Roof
Stairs
321
323 B. Daugherty
M.L. Lorch
F. Monaschs
M. Opacic
326
O & M Staff
325
Computer
327
Machine Room
STORAGE
348
347
346
343
344
345
337
338
339
340
MB
IB
CLASSROOM BUILDING
314
316
318
320
322
324
326
328
Conference
Corridor
EXIT TO
2ND FLOOR
M. Puglia
311
309
307
305
J. Riggs
R. Thomas
329
327
325
EXIT TO
2ND FLOOR OR GO
TO FIRST FLOOR
307
309
311
313
306
310
312
314
EXIT
DORM BUILDING

Figure 4: Third Floor Plan

CPE/jk
6/22/90

CHAPTER 5

Recommendations for accessibility standards for environments used by children with disabilities.

PREFACE

Chapter five represents a culmination of the work of the Research Team and the project Advisory Committee. Prior to the Consensus meeting held in Raleigh, North Carolina, October 15 & 16, 1991, the Advisory Committee reviewed the Task Reports 1-4. These and the results of the Consensus Meeting provided the material for the Final Technical Paper.

Draft recommendations for the accessibility standards were presented for review by the Advisory Committee in Task Report 4. It contained summaries of findings and references forming the basis for consensus decisions at the Consensus Meeting. This material can be found in Appendix A of this chapter.

A summary of the complete consensus process can be found in Appendix C.

Only one issue has not been resolved and that is forward and side reach over an obstruction (4.2.5 & 4.2.6). The reasons are noted in the main body of the document at the relevant location. This topic is reserved.

Chapter five contains the post-Consensus Meeting final version of the recommended standards. They address the design requirements for those elements of a building that are necessary to provide *minimam* accessibility for children with disabilities. When a building will be used by a large number of children at the same time, the dimensions and configurations for elements included in these Standards should be commensurate with the number of children who require accessible design features.

The scope of these recommendations apply to environments for pre-kindergarten and elementary school-aged children; essentially, they apply to all environments used by children of all ages.

Recommendations

2. General

Provisions for Children.
The recommendations are presented as additions to the UFAS and are to be used in conjunction with the referenced UFAS provisions.

UFAS 3.5 Definitions

All terms listed in UFAS 3.5 are applicable, with the following additions:

Pre-kindergarten School.
A school which serves children from infancy up until but not including kindergarten.

Elementary School.
A school which serves grades kindergarten through six.

4.2 Space Allowances and Reach Ranges.

All provisions apply with the following additions:

4.2.1 **Wheelchair Passage Width is supplemented by:**
For children using wheelchairs, the minimum clear width for single wheelchair passage shall be 44 in (1118 mm).

4.2.2 **Width of Wheelchair Passing is supplemented by:**
For children using wheelchairs, the minimum clear width for two wheelchairs to pass shall be 88 in.(2235 mm).

4.2.5 **Forward Reach is supplemented by:**
For accessible design features used by children, the maximum high forward reach shall be 36 in (914 mm) and the minimum low forward reach shall be 20 in (508 mm).

Reserve: High forward reach over an obstruction. Insufficient data is available. The applicability of the Bails & Seeger data was questioned by the research team and Advisory Committee. The opinion of the consensus group was that more information was needed. There is also a question about the accuracy of the measures shown in Fig. 5(b) of the current edition of the UFAS standards.

4.2.6 **Side Reach is supplemented by:**
For accessible design features used by children, the maximum high side reach shall be 36 in (914 mm) and the minimum low side reach shall be 20 in (508 mm).

Reserved: High side reach over an obstruction. Insufficient data is available. The applicability of the Bails & Seeger data was questioned by the research team and Advisory Committee. The opinion of the consensus group was that more information was needed.

4.3 Accessible Route.

All provisions apply with the following additions:

4.3.3 **Width is supplemented by:**
In environments used by children, the minimum clear width of an accessible route shall be 44 in (1118 mm)or 88 in (2235 mm) in situations where wheelchairs must pass.

4.3.4 **Passing Space is supplemented by:**
In environments used by children, passing spaces shall be provided 74 in (1879 mm) wide and no more than 100 ft (30 m) apart.

4.3.6 **Surface Textures is supplemented by:**
In environments used by children, the surface of an accessible route shall comply with 4.5.

4.3.7 **Slope**
No modifications recommended.

4.3.8 **Changes in Levels**
No modifications recommended.

4.4 Protruding Objects.

All provisions apply with the following additions:

4.4.1 **General is supplemented by:**
In environments used by children, if objects protrude 4 in (102 mm) or more from the wall, then the object must extend to the floor (see modified Fig. 8(a)).

Any object extending more than 1 in (25 mm) from a wall and located below 30 in (762 mm) above the floor level must extend to the floor (see modified Fig. 8(a)).

4.4.2 **Head Room is supplemented by:**
In environments used by children (see modified Fig. 8(c)).

4.5 Ground and Floor Surfaces.

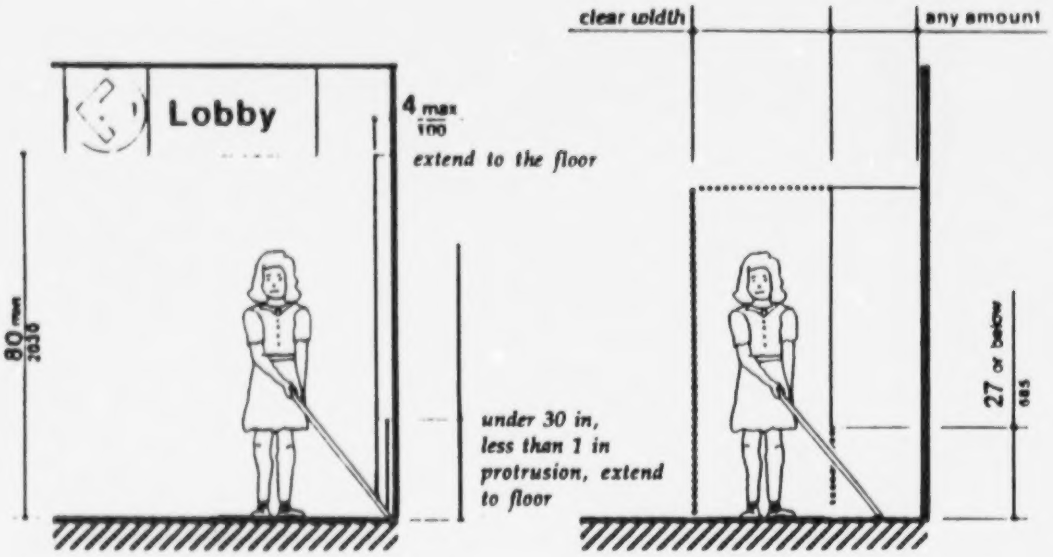
All provisions apply with the following additions:

4.5.1 **General is supplemented by:**
Paved and hard surfaces of all accessible routes and use areas shall be of an even surface.

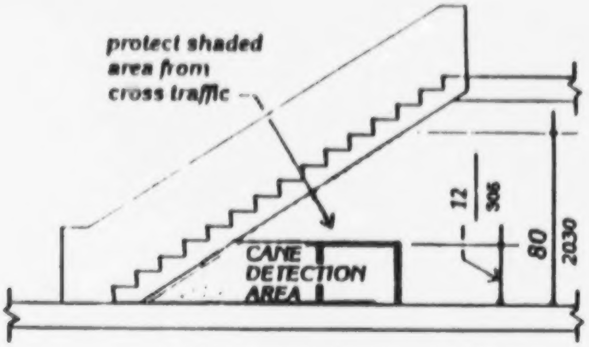
4.5.3 **Carpet is supplemented by:**
In environments used by children, the maximum pile height shall be 1/4 in (6 mm).

4.5.4 **Gratings is supplemented by:**
In *interior* environments used by children, gratings located in walking surfaces shall have spaces no greater than 1/4 in (6 mm) in one direction.

In *exterior* environments used by children, gratings located in walking surfaces shall have spaces no greater than 1/2 in (13 mm) in one direction. Gratings located in an exterior accessible route shall have spaces no greater than 1/4 in (6 mm) in one direction.


clear width
any amount
Lobby
4 max
100
extend to the floor
80 max
2030
under 30 in,
less than 1 in
protrusion, extend
to floor
27 or below
685

(a)
Walking Parallel to a Wall *(Modified)*


protect shaded
area from
cross traffic
CANE
DETECTION
AREA
12
305
80
2030

(c) Overhead Hazards *(Modified)*

Fig. 8
Protruding Objects

4.6 Parking and Passenger Loading Zones

All provisions apply with the following addition:

4.6.5 **Passenger Loading Zone is supplemented by:**
In environments used by children, loading zones shall be protected from the weather and an access aisle 12 by 50 feet (4 by 15 meters) shall be provided. If an accessible route leading to an accessible loading zone is covered, then the cover must extend to the accessible loading zone.

4.6.6 **Vertical Clearance is supplemented by:**
In environments used by children, minimum clear vertical clearance between the vehicular paving and the underside of the cover shall be 15ft (5 m).

4.6.7 **Cover (additional requirement):**
In environments used by children arriving and departing by bus, a protective cover shall extend the length of the loading area. The covered protection directly over waiting cars and/or buses shall be a minimum of 20 ft (6 m) in length and extend a minimum of 6ft (2 m) over the stopped vehicle's drop-off lane or aisle.

4.7 Curb Ramps

All provisions apply with the following addition:

4.7.1 **Location**
Curb ramps complying with 4.7 shall be provided wherever an accessible route crosses a curb. Curb ramps are not necessary where there is no level change between the sidewalk and the street.

4.8 Ramps

All provisions apply with the following addition:

4.8.2 **Slope and Rise is supplemented by:**
In environments used by children, the maximum slope of a ramp in shall be 1:20. Where 1:20 is not feasible, the minimum feasible slope must be built to insure access and useability by children. When 1:20 is not feasible, a maximum slope of 1:16 is permitted.

In alterations, when a 1:16 ramp is technically unfeasible, a maximum slope of 1:12 will be permitted if the level change does not exceed 6 in (152 mm).

The maximum horizontal run for any slope shall be 20 feet (6 meters).

4.8.3 **Clear Width is supplemented by**
In environments used by children, the minimum clear width of ramps shall be 44 in (1118 mm). The minimum clearance width for two wheelchairs to pass shall be 88 in (2235 mm).

4.8.4 **Landings is supplemented by:**
(5) When a turn into vehicular traffic is required at the bottom of a ramp, the turn must be located beyond the 60 in (1524 mm) clear landing.

4.8.5 **Handrails is supplemented by:**
(5) In environments used by children, the top of handrail gripping surfaces shall be mounted between 16 in (406 mm) and 26 in (660 mm) (depending on the ages of the children served), in addition to the UFAS standard handrail gripping surfaces mounted between 30 in (762 mm) and 34 in (864 mm) above ramp surfaces.

4.9 Stairs

All provisions apply with the following addition:

4.9.4 **Handrails (stair) is supplemented by:** In environments used by children, a second handrail shall be provided with gripping surfaces mounted between 16 and 26 in (406 and 660 mm) (depending on the ages of the children being served), in addition to the UFAS standard handrail gripping surfaces mounted between 30 in (762 mm) and 34 in (864 mm) above stair nosings.

4.9.5 **Detectable Warnings at Stairs is supplemented by:** In environments used by children, a combination of two or more different types of warnings shall be provided, extending a minimum of 36 in (914 mm) from the top nosing. Detectable warnings shall contrast from the adjacent walkway surface through the use of sound, resilience, texture and/or inclined surfaces as warning cues.

Physical barriers such as gates, doors, or bollards should be used on exterior stairs to prevent wheelchair access to the stair.

4.10 Elevators

All provisions apply with the following additions:

4.10.3 **Hall Call Buttons is supplemented by:**
Call buttons in elevator lobbies and halls, which are to be used by children, shall be at a maximum height of 36 in (914 mm) above the floor to the top of upper button (see modified Fig. 20). Call buttons shall be a minimum of 1 1/2 to 2 in (38 to 51 mm) diameter and a minimum of 1 in (25 mm) apart. The "up" button shall be on top.

4.10.5 **Raised Characters on Hoistway shall be supplemented by:**
At hoistway entrances used by children, the centerline of the characters shall be 36 to 48 in (914 to 1219 mm) above the floor.

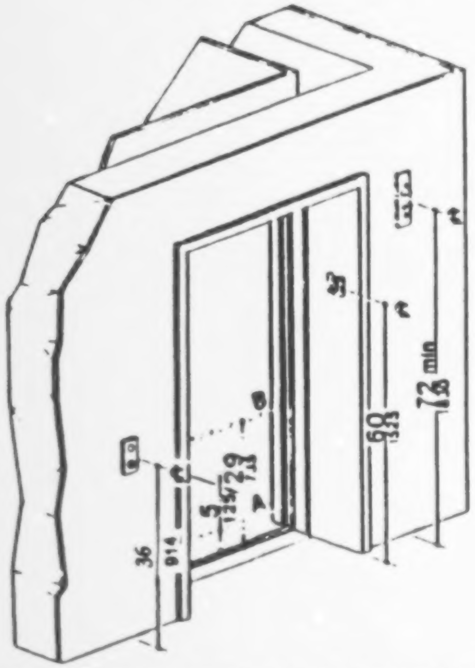
4.10.9 **Floor Plan of Elevator Cars**
No data could be found to support the Florida 1 in (25 mm) wide clearance standard instead of UFAS 1 1/4 in.(32 mm) Consensus meeting group did not consider it to be a critical issue. Therefore, the existing UFAS standard is recommended.

4.10.12 **Car Controls is supplemented by:**

(3) All floor buttons to be used by children shall be no higher than 36 in (914 mm) above the floor. (See modified Fig. 23(b)). Emergency controls, including the emergency alarm and emergency stop, shall be grouped at the bottom of the panel and shall have their centerlines no less than 24 to 30 in 610 to 762 mm) above the floor (see modified Fig. 23(b)).

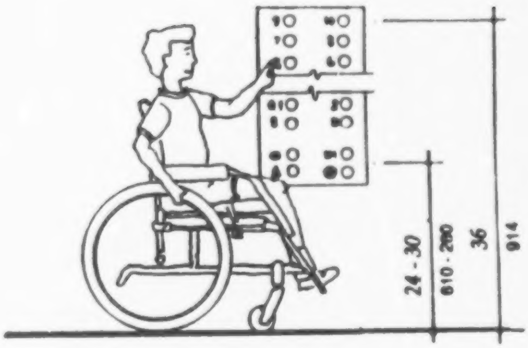
4.10.14 **Emergency Communications is supplemented by** (same as ATBCB recommendation):
The highest operable part of a two-way communication system to be used by children shall be a maximum of 36 in (914 mm) from the floor of the car. It shall be identified by a raised symbol and lettering complying with 4.30, as supplemented by these recommendations, and located adjacent to the device. If the system is located in a closed compartment, the compartment door hardware shall conform to 4.27, Controls and Operating Mechanisms, as supplemented by these recommendations.

Note: Elevators to be used exclusively by adults (e.g., freight elevators) would follow the specifications in UFAS 4.10. Elevators to be used by both children and adults may follow these recommended specifications (which, though lower, should be usable by adults, including those in wheelchairs); or alternatively, one set at the UFAS 4.10 height and one set at heights appropriate for children.


36
914
5
125
29
735
A
B
60
1525
72 min
1830

NOTE: The automatic door reopening device is activated if an object passes through either line A or line B. Line A and line B represent the vertical locations of the door reopening device not requiring contact.

Fig. 20 (Modified)
Holstway and Elevator Entrances


24 - 30
610 - 760
36
914

(b)
Control Height

Fig. 23 (Modified)
Car Controls

4.13 Doors

All provisions apply with the following addition:

4.13.8 **Thresholds at Doorways is supplemented by:**
Thresholds at external doorways used by children shall not exceed 1/2 in (13 mm).

4.13.9 **Door Hardware is supplemented by:**
Hardware required for accessible doors used by children shall be mounted no higher than 30 to 34 in (762 to 864 mm) above the floor. If the hardware is a panic bar, it shall be mounted 30 to 36 in (762 to 914 mm) above the floor.

4.13.11 **Door Opening Force is supplemented by:**
The maximum force for pushing or pulling open a door used by children shall be as follows:

Pre-kindergarten	3 lbf
Kindergarten and older	5 lbf

4.15 Drinking Fountains and Water Coolers

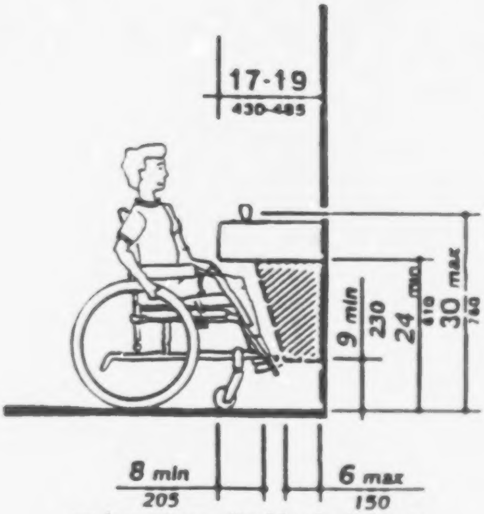
All provisions apply with the following additions:

4.15.2 **Spout Height**
(Same as ATBCB Recommendation.). Spouts on drinking fountains and water coolers used by children shall be no higher than 30 in (762 mm), measured from the floor or ground surfaces to the spout outlet. (See modified Fig. 27(a))

Note: Placement at the children's height requirement will also meet the adult height requirement in spaces used by both children and adults.

4.15.4 **Fountain controls is supplemented by:**
Controls used by children shall be push bar and electronic type and hand operable. The push bar shall be front or front and side mounted.

4.15.5 **Clearances is supplemented by:**
(1) Wall- and post-mounted cantilevered units used by children shall have a knee space between the bottom of the apron and the floor or ground a minimum of 24 in (610 mm) high, 17 in (432 mm) deep and 36 in (914 mm) wide to the sides of the recess.


17-19
430-485
9 min
230
24 min
610
30 max
760
8 min
205
6 max
150

equipment permitted in shaded area

(a)
Spout Height and
Knee Clearance

Fig. 27 (Modified)
Drinking Fountains and Water Coolers

4.16 Water Closets

All provisions apply with the following additions:

4.16.3 **Height is supplemented by:**
The height of water closets used by children shall be measured to the top of the toilet seat (see modified Fig. 29(b)):

Pre-kindergarten	11 1/2 to 12 1/2 in. (292 to 318 mm)
Kindergarten to third grade	12 to 15 in. (305 to 381 mm)
Fourth grade and older	15 to 17 in. (381 to 432 mm)

4.16.4 **Grab Bars is supplemented by:**

4.16.4a 18 to 20 in (457 to 508 mm) above the floor to top of side bar; no back bar.
20 to 25 in (508 to 635 mm) above the floor to top of side bar.* 25 to 27 in (635 to 686 mm) above the floor to top of side bar.*

* Consensus group noted that there is a need to check height of tank/flush valve (industry standard). Side bar heights will likely not work at back. If so, back bar to be at lowest height to permit free hand movement along bar.

4.16.4b (New requirement; no parallel in 4.16.4, except as shown in Fig. 28)
Distance from the center line of the bowl to wall on which side grab bar is mounted shall be:

Pre-kindergarten	11 in (279 mm).
Kindergarten to third grade	11 to 15 in (279 to 381 mm).
Fourth grade and older	15 to 18 in (381 to 457 mm).

4.16.4c (New requirement here - currently governed by rail/bar diameter 4.26.2).
Nominal diameter of grab bars in toilets to be used by children shall be:

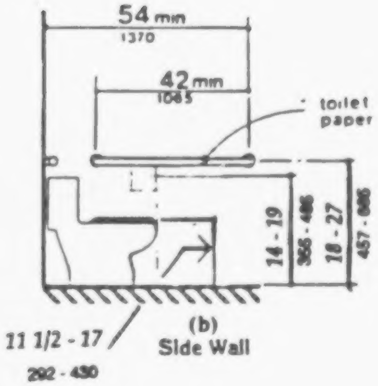
Pre-kindergarten	1 in. (25 mm).
All others	1 to 1 1/4 in (25 to 32 mm).

4.16.5 **Flush Controls is supplemented by:**
Controls for flush valves on water closets used by children shall be mounted on the wide side of toilet areas within 20 to 30 in (508 to 762 mm) above the floor.

4.16.6 **Dispensers is supplemented by:**
Toilet paper dispensers used by children shall be installed above the finished floor, on cenetr, as follows:

Pre-kindergarten	14 in. (356 mm)
Kindergarten to third grade	14 to 17 in. (356 to 432 mm)
Fourth grade and older	17 to 19 in. (432 to 483 mm)

The leading edge of the dispenser shall be parallel to the front of the bowl (see modified Fig. 29).


54 min
1370
42 min
1065
toilet paper
14 - 19
356 - 486
18 - 27
457 - 686
11 1/2 - 17
292 - 430

(b)
Side Wall

Fig. 29 (Modified)
Grab Bars at Water Closets

4.17 Toilet Stalls

All provisions apply with the following additions:

4.17.3 **Size and Arrangement is supplemented by:**

Toilet stalls used by children shall comply with the existing standard, with the exception of the alternate 36 in (914 mm) wide stall (existing UFAS Fig. 30(b), which is deleted from this standard.

4.17.4 **Toe Clearance is supplemented by:**
In standard stalls used by children, the front partition and at least one side partition shall provide a toe clearance of at least 9 in (229 mm) (pre-kindergarten) to 12 in (305 mm) (kindergarten and older age groups) above the finished floor.

4.17.6 **Grab Bars is supplemented by . . .**
As per 4.16.4

4.18 Urinals

All provisions apply with the following additions:

4.18.2 **Height:**
Accessible urinals used by children shall be stall-type, or wall-hung with an elongated rim at a maximum of 14 in (356 mm) above the floor.

4.18.4 **Flush Controls is supplemented by:**
Flush controls on urinals used by children shall be mounted no more than 30 in (762 mm) above the floor.

4.19 Lavatories and Mirrors

All provisions apply with the following additions:

4.19.2 **Height and Clearance Is supplemented by:**
Lavatories used by children shall be mounted with the rim or counter surface no higher than 30 in (762 mm) above the finished floor. A clearance of at least 27 in (686 mm) shall be provided from the floor to the bottom of the apron. Knee and toe clearance shall comply with modified Fig. 31. When two or more lavatories are provided in facilities used by pre-kindergarten children, one lavatory with the counter surface no higher than 22 in (559 mm) above the floor shall be provided.

4.19.3 **Lavatory Clear Floor Space Is supplemented by:**
For lavatories used by children, complying with 4.2.4, a clear floor space of 36 in by 55 in (914 by 1397 mm) shall be provided in front of a lavatory to allow forward approach. Clear floor space should not have a slope steeper than 1:50. When lavatory faucets are provided on the side of the rim or counter surface, 32 in (813 mm) clear space shall be provided on the side upon which the faucet is mounted.

4.19.5 **Lavatory Faucets Is supplemented by:**
Lever or push-button faucets shall be mounted on the face of the front apron or on the rim or counter surface no greater than 14 in (356 mm) from the leading edge of the front apron. Force vectors on push-button controls shall be less than 90° and in compliance with 4.27.4. Alternatively, electronic controls can be provided.

4.19.6 **Mirrors Is supplemented by:**
Mirrors used by children shall be mounted over the accessible lavatory with the bottom edge of the reflecting surface no higher than 30 in (762 mm) from the floor or as low as possible if there are conflicts with the faucet handle or backsplash. (See modified Fig. 31.)

If mirrors are provided, a full length mirror shall be provided with the bottom edge no higher than 18 in (457 mm) from the floor and no less than 30 in (762 mm) in length.

4.21 Shower Stalls

All provisions apply with the following additions:

4.21.3 **Seat Is supplemented by:**
The seat provided in shower stalls used by children shall be mounted 12 to 17 in (305 to 432 mm) from the bathroom floor (depending on the ages of the children) and shall extend the full depth of the stall.

4.21.5 **Controls Is supplemented by:**
Faucets and other controls in shower stalls used by children complying with 4.27.4 shall be located as shown in modified Fig. 37 (i.e., at a maximum height of 36 in (914 mm)).

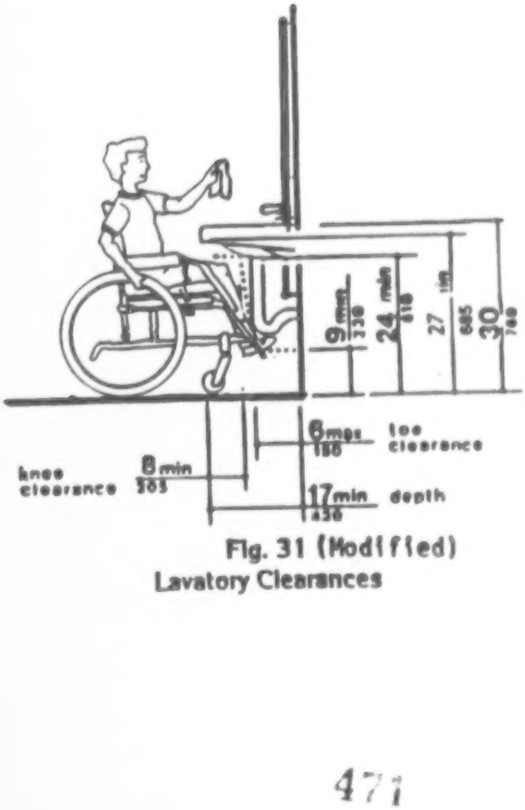
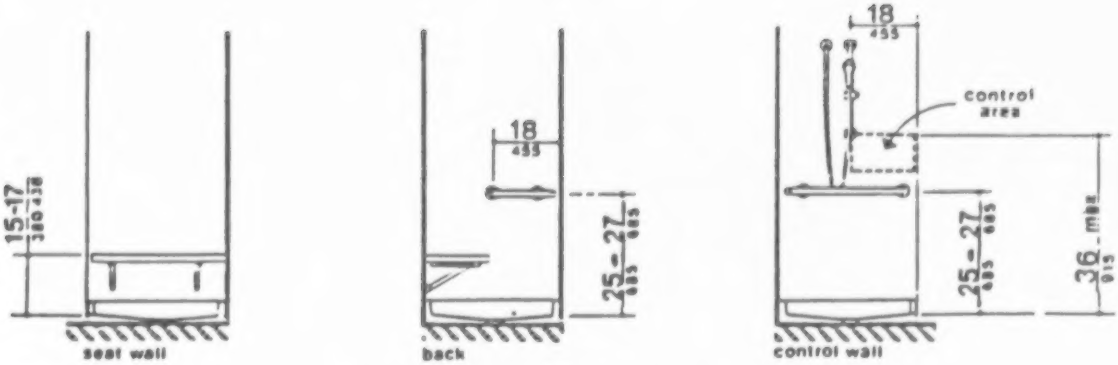
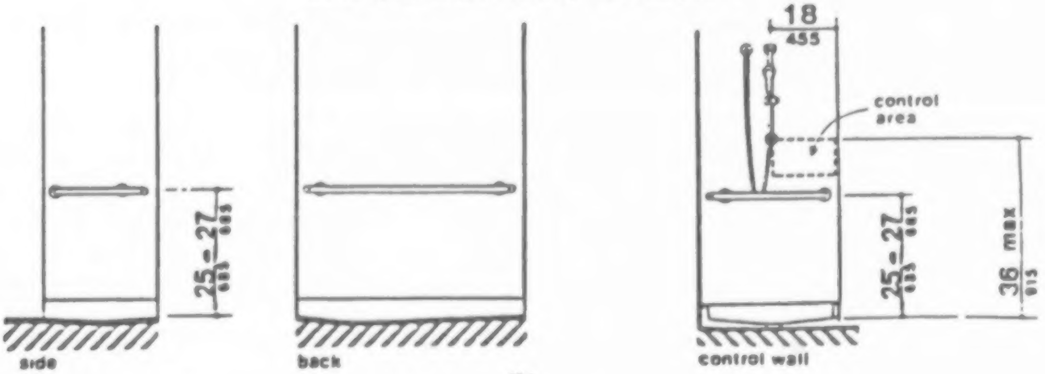

9 max
230
24 min
610
27 min
685
30
760
6 max
150
toe clearance
knee clearance
8 min
205
17 min
430
depth

Fig. 31 (Modified)
Lavatory Clearances


15-17
380-430
seat wall
18
455
25-27
685 685
back
18
455
control area
25-27
685 685
36 max
915
control wall

(a)
36-in by 36-in (915-mm by 915-mm) Stall


25-27
685 685
side
back
18
455
control area
25-27
685 685
36 max
915
control wall

(b)
30-in by 60-in (760-mm by 1525-mm) Stall

Fig. 37 (Modified)
Grab Bars at Shower Stalls

4.22 Toilet Rooms

4.22.1 **Minimum Number.**
This is a scoping issue and therefore outside the frame of reference of the current project.

4.23 Bathrooms, Bathing Facilities, and Shower Rooms

4.23.1 **Minimum Number.**
This is a scoping issue and therefore outside the frame of reference of the current project.

4.24 Sinks

All provisions apply with the following additions:

4.24.2 **Height is supplemented by:** Sinks used by children shall be mounted with the counter or rim no higher than 30 in (762 mm) from the floor.

4.24.3 **Knee Clearance is supplemented by:** Sinks used by children shall provide knee clearance that is a minimum of 24 in (610 mm) high, 17 in (432 mm) deep and 36 in (914 mm) wide.

4.24.5 **Clear floor space is supplemented by:** When lavatory faucets are provided on the side of the rim or counter surface, 32 in (813 mm) clear space shall be provided on the side upon which the faucet is mounted.

4.24.7 **Faucets.**Faucets shall comply with 4.19.5. Levr-operated, push-type, touch-type, or electronically controlled mechanisms are acceptable designs.

4.25 Storage

All provisions apply with the following addition:

4.25.3 **Height is supplemented by:** Accessible shelves and hooks in storage spaces used by children shall be a maximum of 36 in (914 mm) above the floor. (See modified Fig. 38) Adjustable height shelving and storage is recommended.

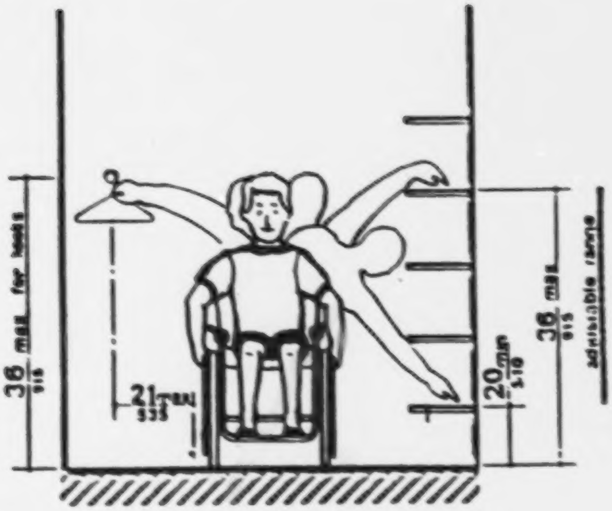

38 max for hooks
915
21 min
533
20 min
510
38 max
915
adjustable range

Fig. 38 (Modified)
Storage Shelves and Closets

4.27 Controls and Operating Mechanisms

All provisions apply with the following additions:

4.27.3 **Height is supplemented by:**
The highest operable part of all controls, dispensers, receptacles, and other operable equipment used by children shall be placed no higher than 36 in (914 mm) and no lower than 20 in (508 mm) above the finished floor.

4.27.4 **Control Operation is supplemented by:**
For controls and operating mechanisms used by children, the force required to activate controls shall be no greater than 3 lbf.

4.30 Signage

All provisions apply with the following addition:

4.30.1 **General:**
Signage is defined as visual, tactile, or auditory means of conveying information, implemented in such a way as to effectively communicate information about the building. Two or more of these means of communication should be provided.

Where all features in a facility are not accessible, then directional signage is required to the features that are accessible. Additionally, the accessible features shall be identified with signage.

When tactile or visual signage is used, it shall comply with 4.30.

Talking signs, attended information booths and interactive computers are acceptable forms of auditory signage.

4.30.6 **Mounting Height is supplemented by:**
Signs for use by children shall be mounted at a height no higher than 48 in (1219 mm) to the sign centerline above the floor.

4.30.7 **Lighting:**
Uniform lighting shall be provided.

4.31 Telephones

All provisions apply with the following:

4.31.3 **Mounting Height is supplemented by:** (Same as ATBCB recommendation). If intended for use by children, the highest operable part of the telephone shall be 36 in (914 mm) above the finished floor. Telephones used by children shall be installed in accordance with modified Fig. 44.

4.32 Seating, Tables, and Work Surfaces

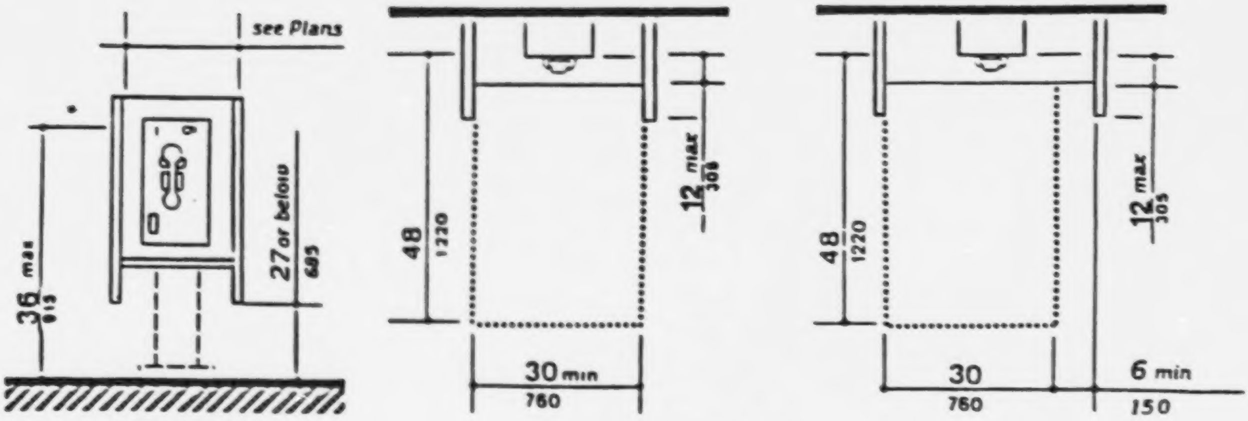
All provisions apply with the following additions:

4.32.2 **Seating is supplemented by:** Chairs used by children shall have backs and arms and have the following heights:

Pre-kindergarten	8 to 12 in. (203 to 305 mm)
Kindergarten and older	12 to 17 in. (305 to 432 mm)

4.32.3 **Knee Clearances is supplemented by:** Tables, counters, and work surfaces provided for children in wheelchairs shall have clear knee space 24 in (610 mm) high, and 24 in (610 mm) deep and 30 in (760 mm) wide. Wherever possible, adjustable-height work surfaces shall be provided.

4.32.4 **Height of Work Surfaces is supplemented by:** The tops of tables and work surfaces used by children shall be a maximum of 2 in (51 mm) higher than the upper end of the knee clearence range from the floor or ground. Where possible, adjustable height work surfaces shall be provided.


see Plans
*
36 max
915
27 or below
685
48
1220
12 max
305
30 min
760
48
1220
12 max
305
30
760
6 min
150

Elevation

Plans

*Height to highest operable parts which are essential to basic operation of telephone.

(b)
Forward Reach Required

Fig. 44 (Modified)
Mounting Heights and Clearances for Telephones

5. Restaurants and Cafeterias

All provisions apply with the following additions:

5.1 **General is supplemented by:**
In addition to the requirements of UFAS 4.1 to 4.33, the number of seats and tables (commensurate with the number of children using wheelchairs but at least 5% of all fixed seating or tables in a cafeteria used by children) shall comply with 4.32 as supplemented by these recommendations and the recommendations listed below.

Access aisles between tables shall comply with 4.3. Where practical, accessible tables should be distributed throughout the space or facility. Accessible toilet rooms should be provided near the cafeteria and shall comply with UFAS 4.22 or 4.23 and the recommendations for water closets, urinals, lavatories and mirrors, shower stalls and sinks listed in this document.

5.2 **Food Service Lines is supplemented by:**
Tray slides used by children shall be mounted no higher than 30 in (762 mm) above the floor (see modified Fig. 53). The maximum forward/side reach by children for food service in a staffed service lineis 15 in (381 mm) from the leading edge of the tray slide. If self service shelves are provided, a reasonable proportion must comply with 4.2.5 and 4.2.6. If a tray slide is provided, at least one item of each type in a self service line shall be at or above the height of the counter.

5.3 **Tableware Areas is supplemented by:**
Tableware, dishware, condiment, food and beverage display shelves, and dispensing devices used by children shall be installed in compliance with 4.2, as supplemented by these recommendations (see modified Fig. 54).

5.4 **Vending Machines is supplemented by:**
Install vending machines used by children shall be installed in compliance with 4.27, as supplemented by these recommendations.

8. Libraries

All provisions apply with the following addition:

8.3 **Check-Out Areas is supplemented by:**
Accessible work surfaces used by children in checkout areas shall be a maximum of 30 in (762 mm) above the floor.

8.4 **Card Catalogs is supplemented by:**
(Same as ATBCB): Minimum clear aisle space at card catalogs, magazine displays, dictionary stands, or reference stacks to be used by children shall comply with modified Fig. 55. Maximum reach height shall be 36 in (914 mm).

8.5 **Stacks is supplemented by:**
Stacks used by children shall not exceed 36 in (914 mm) in height.

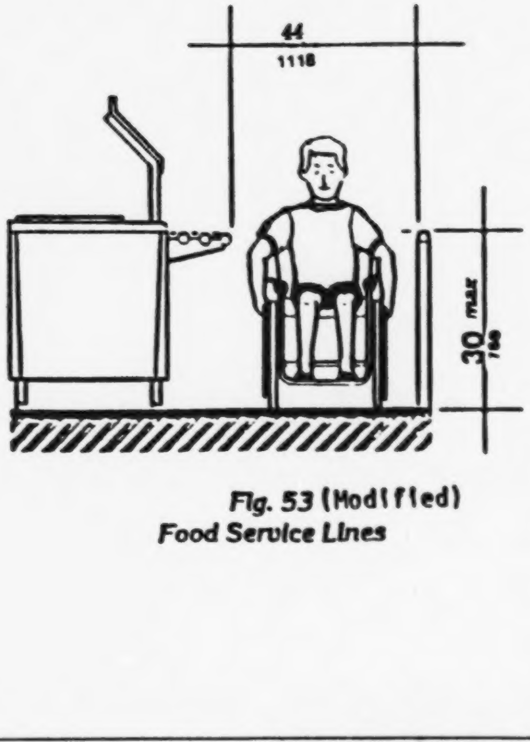

44
1118
30 max
760

Fig. 53 (Modified)
Food Service Lines

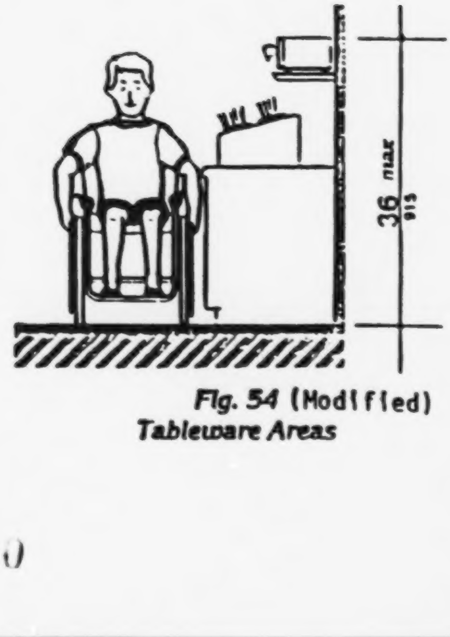


Fig. 54 (Modified)
Tableware Areas

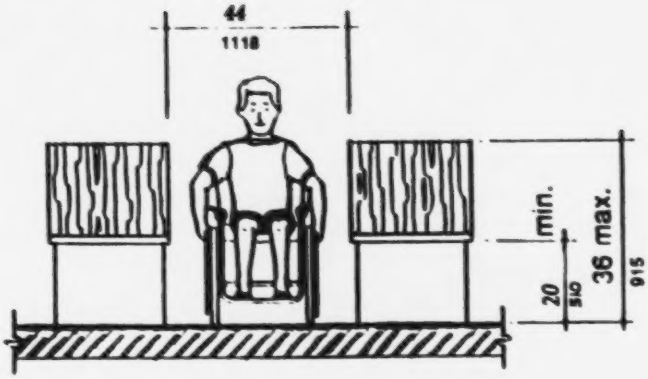

44
1118
min.
20
510
36 max.
915

Fig. 55 (Modified)
Card Catalog

APPENDICES

Appendix A

SUMMARY OF FINDINGS AND REFERENCES, INCLUDING

ATBCB RECOMMENDATIONS

Key to Post-occupancy Evaluation Sites (Chapter 3 references).

BCM: Boston Children's Museum, Boston, MA
GHPS: Preschool Handicapped Classroom Facility, Gainesville, FL
GAB: Georgia Academy for the Blind, Macon, GA
MHS: Massachusetts Hospital School; and MHPS, Baylies Beginning Center, Canton, MA
RES: E. Rivers Elementary School, Atlanta, GA
UCP: United Cerebral Palsy Developmental Center, Spring Lake, NC
WCS: East Wake Middle and Vance Elementary Schools, Raleigh, NC
WPSCB: West Pennsylvania School for Blind Children, Pittsburgh, PA

Note: As an reference aid to the reader, the recommendations contained in the ATBCB publication: *Recommendations for Accessibility to Serve Physically Handicapped Children in Elementary Schools*, March 1986, are presented in the appropriate section.

2. General

ATBCB RECOMMENDATIONS:

Provisions for Children.
The recommendations are presented as additions to the UFAS and are to be used in conjunction with the referenced UFAS provisions.

UFAS 3.5 Definitions

All terms listed in UFAS 3.5 are applicable, with the following additions:

Elementary School.
A school which serves grades one through six.

4.2 Space Allowances and Reach Ranges.

SUMMARY OF FINDINGS & REFERENCES:

4.2.1 Wheelchair Passage Width. Evidence is contradictory, although all sources agree UFAS 36 in is too narrow for children who are often less skilled at wheelchair control than adults. New standard should be at least 45 in for single wheelchair passage, but 72 in is preferable.

- Ch. 1 (N.C., p. 7) stipulates 72 in as a minimum hallway width.
- Ch.3 (Table 1, Maryland, p.3) suggests 48 in.
- Ch. 4 (p.10-11). Widths varied from 43 to 138 in.
- Ch. 4 (p.64) suggests 75 in to allow for two-way traffic.
- Ch. 4 (p.59) suggests "Florida standard of 44-102 in is preferable to UFAS ... in all situations."

4.2.2 Width for Wheelchair Passing. UFAS 60 in min is too small; 84 to 96 in is more reasonable to provide room for two wheelchairs to pass. Allowance sometimes needed for many wheelchairs using same passage (POE, p. 11).

- Ch. 4 (p.91-92) suggests 84 in to 96 in.

4.2.3 Wheelchair Turning Space. No objection to UFAS 60 in diameter.

- Ch. 4 (UCPDC Table 1, p.24) observed 60 in as sufficient space.

ATBCB RECOMMENDATIONS:

4.2.5 Forward Reach and 4.2.6 Side Reach are supplemented by:

Elementary School Reach Ranges.
The maximum high forward or side reach range to an object is 36 in (915 mm) and the minimum low forward or side reach is 20 in (510 mm).

SUMMARY OF FINDINGS & REFERENCES:

4.2.5 Forward Reach UFAS overestimates children's reach at 48 in. Task reports 1-3 did not support a specific alternative measure; however, there was a tendency toward the range 30-34 in.

- Ch. 1 (Florida 3.14.9, p.48) stipulates 30-34 in for door hardware reach;
- Ch. 2 (Table 11, p.14) stipulates 30-34 in for door hardware reach;
- Ch. 4 (p.59) lends support for approximately 44 in.

4.2.6 Side Reach UFAS max (54 in) is too high. Most studies suggest 36 in for children.

- Ch. 1 (Florida 3.12.14, p. 41; 5.2.5.2, p.77) allows 36 in for important reach goals.
- Ch. 1 (N.C., p.42, 78) concurs with 36 in.
- Ch. 3 (Table 13, People's Housing, p.16) sets 36 in for reach goals.
- Ch. 4 (p. 21) concluded that 36 to 48 in would work best for most children than current UFAS.

- Regarding reach over obstruction, Ch. 4 (p.108) notes: "Design specification should not presume the type of full armed sweep diagrammed in Figure 6 of the UFAS." Study suggests a 10 x 32 in object maximum instead of the UFAS 24 x 34 in.

4.3 Accessible Route

SUMMARY OF FINDINGS & REFERENCES:

4.3.2 Accessible Route Location.
Accessible routes should not be relegated to "back door" entries only.

- Ch. 1 (Florida 3.2.1, p.6) specifies that accessible routes connect major entries, and no users should be forced to use secondary or rear entries.
- Ch. 4 (p.129) travel distance between building was a major issue.

4.3.3 Width.
Data is contradictory, although all agree UFAS 36 in is too narrow for children, who are often less skilled at wheelchair control than adults. New standard should be at least 45 in for single wheelchair passage; but 72 in is preferable as it allows for wheelchair passing.

Exterior:
- Ch. 1 (Florida 3.3.2, p.7) stipulates 60 in min for secondary exterior routes; 84 in min for primary routes.

Interior:
- Ch. 1 (N.C., p.7) stipulates min. 72 in. Ch. 1 (Florida 3.3.3, p.7) stipulates 114 in for hallways and 44 in for aisles.
- Ch. 4 (Table 1, 24) observed routes from 43-138 in.
- Ch. 4 (p.59) "Florida standard (44-102 in) is preferable to UFAS 36-48 in in all situations."

4.3.4 Passing Space.
UFAS (60 in every 100 ft) is not enough; passing spaces should be provided twice as frequently.

- Ch. 1 (Florida 3.5, p. 6) stipulates 60 in every 100 feet for exterior passing space.
- Ch. 3, (Table 1, People's Housing and Moore, p.3) supports UFAS.
- Ch. 4 (p.59) "In places where children gather, we recommend Florida standards."

4.3.6 Surface Textures.
UFAS offers guidelines, no specifications.

- Ch. 1 (Florida 3.7.2, p.11) goes in-depth regarding materials & specifications.

4.3.7 Slope.
Some support for UFAS 1:20 slope.

- Ch. 1 (Florida 3.4, p.9) supports UFAS 1:20.

4.3.8 Changes In Levels.
Evidence supports UFAS height of .5 in.

- Ch. 1 (Florida 3.6.2, p.10)
- Ch. 3 (Table 1, Moore, Maryland, p.3)
- Ch. 4 (GAB, Table 1, p.24).

4.4 Protruding Objects

SUMMARY OF FINDINGS & REFERENCES:

4.4.1 Protruding Objects: General
Visually impaired children require protrusions to be lower than UFAS (27 in AFF) in order to detect them with a cane. UFAS max protrusion of 4 in from the wall is not disputed.

- Ch. 1 (Florida 3.19.1, p.57) stipulates 12 in AFF height for objects' leading edges instead of UFAS 27 in.
- Ch. 3 (Table 8, Moore, People's Housing, p.11) supports UFAS 4 in max protrusion from wall.
- Ch. 4 (p.134) notes that *any* protrusions are dangerous where visually impaired individuals maneuver without assistance of a cane.

4.5 Ground and Floor Surfaces.

SUMMARY OF FINDINGS & REFERENCES:

4.5.1 Ground & Floor Surfaces; General
UFAS: "Ground and floor surfaces . . . shall be stable, firm, [and] slip-resistant."

4.5.2 Changes in Level
Evidence supports UFAS height max of 1/2 in

- Ch. 1 (p.10)
- Ch. 3 (Table 2, Moore & Maryland, p.5)

4.5.3 Carpet
UFAS carpet pile height of 1/2 in is too deep. 1/4 in in is preferred.

- Ch. 1 (Florida 3.6.4, p.13) stipulates .25 in max pile height.
- Ch. 3 (Table 1, People's Housing, p.3-4) suggests 1/4 in.

4.5.4 Gratings
UFAS max width (1/2 in) for grating spaces is too large; 1/4 in would be preferred.

- Ch. 1 (Florida 3.6.5, p.11)

4.5.5 Hygiene and Sanitation
UFAS makes no mention of hygiene and sanitation of floor surfaces.

- Ch. 1 (Florida 3.6.6, p.11) proscribes that "all flooring materials shall be able to withstand frequent cleaning with industrial or hospital-strength cleansers."

4.5.6 Corners
UFAS makes no recommendation on corners.

- Ch. 1 (Florida 3.6.7, p.11) requires outside corners in hallways to be rounded, or else protected to a minimum height of 24 in.

4.5.7 Finishes and Materials for Exterior Accessible Routes
UFAS makes no recommendations for finishes and materials.

- Ch. 1 (Florida 3.7.2, p.12) gives specifications for wood, concrete, asphalt, and other materials.

4.6 Parking and Passenger Loading Zones

ATBCB RECOMMENDATIONS:

All provisions apply with the following addition:

4.6.5 Elementary School Loading Zones is supplemented by:
Loading zones shall be protected from the weather, if necessary. The zones should be 12 ft (4m) wide by 50 ft (15m) long to accommodate buses and vans.

Note: UFAS does not specify the size of passenger loading zones, but rather of the required access aisle since loading zones are designed for typical vehicles. Because handicapped children are brought to school by bus or auto which may be arriving simultaneously with other buses or vehicles, it is important to assure a loading zone size that will accommodate buses or vans discharging handicapped children without delaying the unloading of other school buses.

SUMMARY OF FINDINGS & REFERENCES:

4.6.5 Passenger Loading Zone
A single large loading zone (12 x 50 ft) is preferable to several small zones.

- Task I (Florida 4.3.3, p.70) specifies 12 x 60 ft. This is larger than both UFAS (5 x 20 ft) and ATBCB (12 x 50 ft).
- Ch. 3 (Table 11, People's Housing, p.14) suggests 12 x 50 ft.
- Ch. 4 (p.14-15) reports on several drop-off zones and notes the usefulness of larger spaces in settings where there are a number of disabled children loading or unloading at the same time.

4.6.6 Vertical Clearance
Vertical clearance must be high enough to allow vehicle entry but low enough to offer weather protection. UFAS specifies 114 in.

- Ch. 1 (Florida 4.3.4, p.72) stipulates 180 in high.
- Ch. 3 (Table 11, p. 14) no data.
- Ch. 4 (p.15) found clearance to be too high for protection against the rain.

4.8 Ramps

ATBCB RECOMMENDATIONS:

All provisions apply with the following addition:

4.8.5 (5) **Handrails is supplemented by:** Top of handrail gripping surfaces for children shall be mounted between 26 in and 28 in (660 mm and 710 mm) above stair nosings.

Note: Handrails in spaces used by both adults and children should be provided at the adult height, as specified in UFAS, with a second handrail at the appropriate height for children as required here. The handrails shall be spaced to ensure access to both upper and lower rails. The range of acceptable mounting height (30-34in for adults, 26-28 in for children) is sufficiently broad to allow such placements.

SUMMARY OF FINDINGS & REFERENCES:

4.8.2 **Slope and Rise**
UFAS max 1:12 is too steep for children, 1:16 is preferable.

- Ch. 1 (Florida 3.8.2, p.18) supports UFAS slope of 1:12.
- Ch. 4 (p.113) observed great difficulties with slopes close to UFAS 1:12.
- Ch. 4 (p.11). Staff explicitly recommended slope of 1:16.

4.8.3 **Clear Width**
UFAS guide of 36 in is acceptable only for low-traffic areas.

- Ch. 3 (Table 7, People's Housing, 10) supports UFAS 36 in wide.
- Ch. 4 (p.11): Min of 36 in is acceptable, but wider ramps recommended in areas with large numbers of children using wheelchairs.

4.8.5 **Ramp Handrails**
UFAS height 30-34 in is too high. For maximum flexibility, a double rail with supports at 2 heights is suggested.

- Ch. 1 (Florida 3.9.2, p.23) supports ATBCB's low (26 in) figure, requiring a children's lower rail (24 in) below a higher one (30 in).
- Ch. 3 (Table 2, NYS, p.5) goes lower still (16-24 in)
- Ch. 4 (p.59): The Florida standard of two rail heights (20 and 30 in) is preferable to one compromise height.

4.9 Stairs

SUMMARY OF FINDINGS & REFERENCES:

4.9.4 **Handrails (stair)**
Children need lower stair handrails than UFAS.

- Ch. 1 (N.C., p.29) and Ch. 3 (Table 4, People's Housing, p.7) both recommend height range of 26-28 in. This is lower than UFAS (30-34 in).
- Ch. 4 (p.12) observed handrails of 32-34 in. No evaluations were given except that a lack of handrails can create great difficulties.

4.9.5 **Tactile Warnings at Stairs.**
Although often absent, the presence of tactile stair warnings can be an asset to visually impaired children.

- Ch. 4 (p.12): the absence of warning strips was problematic for visually impaired children. The warning strip should be "wider" than 12 in and extend 36-48 in back from the first nosing.

4.10 Elevators

ATBCB RECOMMENDATIONS:

All provisions apply with the following additions:

4.10.3 **Hall Call Buttons is supplemented by:**
Call buttons in elevator lobbies and halls which are to be used by children shall be centered at 34 in (865 mm) above the floor. The button designating the up direction shall be on top (see modified Fig 20)

4.10.5 **Raised Characters on Hoistway Entrances is supplemented by:**
The mounting height specified by UFAS for raised characters on hoistway entrances is not appropriate for tactile use by children. Designers may propose modifications to UFAS based on the particular population served by a given elevator, or they may propose mounting supplementary characters at a lower height.

4.10.12 **(3)Car Controls is supplemented by:**

All floor buttons to be used by children shall be no higher than 36 in (915 mm) above the floor (see modified Fig. 23(b)).

4.10.14 **Emergency Communications is supplemented by:**
The highest operable part of a two-way communication system to be used by children shall be a maximum of 36 in (915 mm) from the floor of the car. It shall be identified by a raised symbol and lettering complying with 4.30, as supplemented by these recommendations, and located adjacent to the device. If the system is located in a closed compartment, the compartment door hardware shall conform to 4.27, Controls and Operating Mechanisms, as supplemented by these recommendations.

Note: Elevators to be used exclusively by adults (e.g., freight elevators) would follow the specifications in UFAS 4.10. Elevators to be used by both children and adults may follow these recommended specifications (which, though lower, should be usable by adults, including those in wheelchairs), and one set at the UFAS 4.10 height and one set at heights appropriate for children.

SUMMARY OF FINDINGS & REFERENCES:

4.10.3 Hall Call Buttons
UFAS allows for buttons that are both too high (42 in) and too small (3/4 in diameter) for children.

- Ch. 1 (Florida 3.12.3, p.34 and N.C, p.35) both stipulate 36 in max height.
- Ch. 4 (p.60) The UFAS Standard is too high. "The Florida standard of 34-36 in would be usable by most of the children, but UFAS would not."

- Ch. 1 (Florida 3.12.3, p.34) stipulates 1 in diameter as the smallest dimension, with *min 2 in at center* with tactile up/down indication.
- Ch. 3 (Table 5, NYS, p.8) follows UFAS.
- Ch. 4 (p.12-3) observed that buttons within UFAS height and diameters were still too high and too small for children.

4.10.9 Floor Plan of Elevator Cars
Data is scarce; UFAS is supported by Florida codes.

- Ch. 1 (Florida 3.12.9, p.38) reads same as UFAS, but allows for 1 in wide clearance from platform to hoistway instead of UFAS 1 1/4 in.

4.10.12 Car Controls
Just as with 4.10.3, UFAS standards are inadequate and Florida rules (36 in) are recommended.

Height
- Ch. 1 (Florida 3.12.3, p.34 and N.C., p.35) both stipulate 36 in max height for car buttons and 23 in for emergency buttons.
- Ch. 4 (p.60) "The Florida standard of 34-36 in would be usable by most of the children, but UFAS would not."

Button Size
- Ch. 1 (Florida 3.12.3, p.34) stipulates 1 in diameter at smallest measure, with *min 2 in at center* with tactile indication.
- Ch. 4 (p.13) observed that 1 in buttons, although larger than UFAS min, are still not big enough for some children with limited hand and finger control.

4.10.14 Emergency Communications
Consensus agrees that UFAS max 48 in is too high and ATBCB recommendation of 36 in is preferred.

- Ch. 1 (Florida 3.12.14, p.41) concurs with 36 in max and allows for 23 in min.
- Ch. 1 (N.C. p.42) agrees with 36 in.
- Ch. 3 (Table 5, NYS, p.8) agrees with 36 in.
- Ch. 4 (p.13) observed that buttons at UFAS requirements were too high.

4.13 Doors

ATBCB RECOMMENDATIONS:

All provisions apply with the following addition:

4.13.9 **Door Hardware is supplemented by:**
Hardware required for accessible door passage to be used by children shall be mounted no higher than 36 in (915 mm) above the finished floor.

SUMMARY OF FINDINGS & REFERENCES:

4.13.5 **Clear Width**
UFAS 32 in min width is supported.

- Ch. 1 (p.43)
- Ch. 3 (Table 6, p.9)
- Task 3 No problems related to door width were reported or observed (POE, p.13).

4.13.8 **Thresholds at Doorways**
Evidence suggests UFAS indoor max .5 in is appropriate.

- Ch. 1 (Florida 3.14.8, p.47) stipulates .5 in.
- Ch. 3 (Table 6, p.9) suggests .5 in or less.
- Ch. 4 (p.60): "having no thresholds in interior doors is preferable to even a 1/2" beveled threshold."

4.13.9 **Door Hardware**
Hardware at UFAS max 48 in is too high for children, but ATBCB's 36 in is too low for adults. 40 in may be a good compromise for doors used by both.

- Ch. 1 (Florida 3.14.9, p.48) specifies the lowest height, 30-34 in.
- Ch. 1 (N.C., p.48) also goes low, 30 in.
- Ch. 3 (Table 6, p.9) reports no findings.
- Ch. 4 (p.13) found hardware at 39-41 in AFF *"worked well for children as well as adults."*

4.13.11 **Door Opening Force**
While data is scarce and contradictory, Task 3 observations indicate UFAS standards (5 lbf) can be dangerous for children, and 3 lbf or less is preferred wherever possible.

- Ch. 1 (Florida 3.14.11, p.48) conforms to UFAS (5 lbf).
- Ch. 3 (Table 6, NYS, People's Housing, p.9) supports UFAS.
- Ch. 4 (p.95): The MHS children, who were severely/multiply disabled, found it impossible to exert even 3 lbf. At such times children resort to unsafe practices such as running into glass doors with power chairs on "high."

4.15 Drinking Fountains and Water Coolers

ATBCB RECOMMENDATIONS:

All provisions apply with the following additions:

4.15.2 **Spout Height is supplemented by:**
Spouts on drinking fountains and water coolers used by children shall be no higher than 30 in (760 mm), measured from the floor or ground surfaces to the spout outlet. (See modified Fig. 27(a))

Note: Placement at the children's height requirement will also meet the adult height requirement in spaces used by both children and adults.

SUMMARY OF FINDINGS & REFERENCES:

4.15.2 **Fountain Spout Height**
Data supports ATBCB (30 in) or lower.

- Ch. 3 (Table 18, People's Housing, p.21) supports ATBCB 30 in.
- Ch. 4 (p.69) suggests 24 in "works well" (for pre kindergarten).

4.15.3 **Fountain Spout Location**
Evidence agrees with UFAS that spout be located in front, and water height at 4 in.

- Ch. 1 (Florida 9.1.3, p.119)
- Ch. 3 (Table 18, Moore, p.21)
- Ch. 4 (p.69)

4.15.4 Fountain controls
UFAS does not specify type of control.

- Ch. 1 (Florida 9.1.4, p.119) requires push-bar controls.
- Ch. 3 (Table 18, Moore, People's Housing, p.21) suggest levers & push bars that are hand and foot operable.
- Ch. 4 (p.19) suggests front-mounted controls.

4.15.5 Clearances
UFAS 27 in H x 30 in W x 19 in D should be wider and a lot deeper, according to Florida.

- Ch. 1 (N.C., p.119) stipulates knee space 24 in from floor to bottom of unit.
- Ch. 1 (Florida 9.1.5) stipulates knee space 27 in H x 36 in W x 48 in D.

4.16 Water Closets

ATBCB RECOMMENDATIONS:

All provisions apply with the following additions:

4.16.3 Height is supplemented by:
The height of water closets used by children shall be 15 in-17 in (380 mm-430 mm), measured to the top of the toilet seat (see modified Fig. 29(b)).

4.16.4 Grab Bars is supplemented by:
Grab bars for water closets used by children and not located in stalls shall comply with modified Fig 29 and 4.26.

4.16.5 Flush Controls is supplemented by:

Controls for flush valves on water closets used by children shall be mounted on the wide side of toilet areas no more than 32 in (815 mm) above the floor.

4.16.6 Dispensers is supplemented by:

Toilet paper dispensers used by children shall be installed 19 in (485 mm) above the floor, 18 in-24 in (460 mm-610 mm) from the rear wall (see modified Fig 29).

SUMMARY OF FINDINGS & REFERENCES:

4.16.3 Height
Evidence suggests that UFAS 17-19 in max is too high. Suggested heights range from 12-17 inches, taking age into account. Appropriate heights should allow children to transfer independently and keep their feet on the ground for stability.

- Ch. 1 (Florida 8.3.3, p.90): 12-15 in (age K-3);
- Ch. 1 (N.C., p.90): 15-17 in AFF
- Ch. 1 (Illinois, p.90): 15 in

- Ch. 1 (Texas, p.90): 14-15 in (age 5-11) and 15-17 in (age 11-15).
- Ch. 3 (Table 16, NYS, p.19): 16-17 in.
- Ch. 3 (Table 16, Nellist, p.19): 12 in for nursery.
- Ch. 4 (p.17): 16 in observed to work well (for school-aged children).

4.16.4 Grab Bars for Water Closets not located in stalls

No consensus exists on height or even measurement reference points. The literature indicates that grab bars should be measured from the toilet seat, not the floor, and this distance should be 6-10 in.

- Ch. 1 (N.C., p. 113) 25-27 in AFF.
- Ch. 1 (Calif, 113) 10 in from seat.
- Ch. 1 (Texas, 113) 28-30 in AFF (age 5-11) and 30-32 in AFF (ages 11-15)
- Ch. 3 (Table 16, NYS, p.19) 32 in AFF.
- Ch. 4 (p.66) 6 in from seat for very young children.
- Ch. 4 (p.17, 66) suggests UFAS 1.25 min diameter for grab bars be used instead as a max diameter.

4.16.5 Flush Controls

UFAS max height of 44 in is too high; so is ATBCB's 32 in recommendation. 25-30 in is more reasonable.

- Ch. 1 (Florida 8.3.5, p.92) 30 in AFF
  Ch. 1 (Michigan, p.92) 20 in.
- Ch. 3 (Table 16, 19) no data.
- Ch. 4 (p.16) found flush controls generally at 23-25 in, lower than ATBCB 32 in.

4.16.6 Dispensers

Evidence supports ATBCB's recommended 19 in height.

- Ch. 1 (Florida 8.3.6, p.93) stipulates 18 in AFF, 8 in behind grab bar.
- Ch. 4 (p.16-7), "toilet paper dispenser height tended to exceed the UFAS min of 19 in. 19 in.

4.17.3 Size and Arrangement

UFAS min 36 in is too small. 50-60 in seems more reasonable to allow for side transfers.

- Ch. 3 (Table 16, NYS) suggests 48 in.
- Ch. 3 (Table 16, Nellist, 19) suggests 54 in.
- Ch. 4 (p.17) observed 36 in stalls too small; 60 in works better.

4.17.4 Toe Clearance

Most stalls investigated exceeded UFAS 9 in height min by 3 in.

- Ch. 1 (Florida 8.4.4, p.95) stipulates 18 in.
- Ch. 4 (p.17) found toe clearances higher than 9 in.

4.17 Toilet Stalls

ATBCB RECOMMENDATIONS:

All provisions apply with the following additions:

4.17.6 **Grab Bars is supplemented by:** Grab bars in toilet stalls to be used by children shall be mounted 25-27 in (635 mm-685 mm).

SUMMARY OF FINDINGS & REFERENCES:

4.17.6 **Toilet Stall Grab Bars** The literature is divided on height and measurement reference points. Some references indicate grab bars should be measured from the toilet seat, not the floor, and this distance should be 6-10 in above the toilet seat.

- Ch. 1 (N.C., p. 113) stipulates 25-27 in AFF.
- Ch. 1 (Calif, 113) 10 in from seat.
- Ch. 1 (Texas, 113) 28-30 in AFF (age 5-11) and 30-32 in AFF (ages 11-15)
- Ch. 3 (Table 16, NYS, p.19) 32 in AFF.
- Ch. 4 (p.66) 6 in from seat for very young children.
- Ch. 4 (p.17, 66) suggests UFAS 1.25 min diameter for grab bars be used instead as a max diameter.

UFAS 4.18 Urinals

ATBCB RECOMMENDATIONS:

All provisions apply with the following additions:

4.18.4 **Flush Controls is supplemented by:**
Flush controls on urinals used by children shall be mounted no more than 32 in (815 mm) above the floor.

SUMMARY OF FINDINGS & REFERENCES:

4.18.2 **Urinal Height**
Some contradiction; while some states drop UFAS height (17 in) a few inches, Task 3 found no problems with current standards.

- Ch. 1 (N.C., p.111) stipulates rim at 14 in high.
- Ch. 3 (Table 16, NYS, p.19) suggests 14 in.
- Ch. 3 (Table 16, Nellist, p.19) suggests 24 in.
- Ch. 4 (p. 17) observed "no problems" with urinals of any height (17-28 in).

4.18.4 **Urinal Flush Controls**
The scarce evidence supports ATBCB's 32 in high.

- Ch. 3 (Table 16, NYS, p.19) suggests 32 in.
- Ch. 4 (p.17) found few urinals & observed "no problems."

4.19 Lavatories and Mirrors

ATBCB RECOMMENDATIONS:

All provisions apply with the following additions:

4.19.2 **Height and Clearance is supplemented by:**
Lavatories used by children shall be mounted with the rim or counter surface no higher than 30 in (760 mm) above the finished floor. Provide a clearance of at least 24 in (610 mm) from the floor to the bottom of the apron. Knee and toe clearance shall comply with modified Fig. 31.

4.19.6 **Mirrors is supplemented by:**
Mirrors used by children shall be mounted with the bottom edge of the reflecting surface no higher than 30 in (760 mm) from the floor or as low as possible if there are conflicts with the faucet handle or backsplash. (See modified Figure 31.)

SUMMARY OF FINDINGS & REFERENCES:

4.19.2 **Lavatory Height and Clearances**
Some contradiction; field observation supports ATBCB 30 in high.

- Ch. 3 (Table 17, NYS, p.20) supports UFAS 34 in.
- Ch. 3 (Table 17, Nellist, p.20) suggests 27-33 in.
- Ch. 4 (p.101) supports ATBCB 30 in (for older children).

4.19.3 **Lavatory Clear Floor Space**
Evidence indicates that UFAS 30x48 in floor space may be too restrictive.

- Ch. 1 (Florida 6.3.4h, p.101) stipulates 36x55 in clear floor space.
- Ch. 4 (p.100) severely disabled children who cannot reach over sink need to position themselves between sinks. This suggests a wider clear floor space may be necessary for this population.

4.19.5 Lavatory Faucets
UFAS 4.27.4 allows max 5 lbf requirement, and gives options for types of faucet. Task 3 POEs found front-mounted levers work best both for very young children and children with limited reach range and/or hand control.

- Ch. 4 (p.18) observed that the lever handles worked well for children with limited reach and hand control.
- Ch. 4 (p. 23) observations suggested front-mounted faucets were more accessible to children.

4.19.6 Mirrors
Inconclusive data does suggest UFAS max 40 in too high.

- Ch. 1 (N.C., p. 111) stipulates bottom mirror edge at 34 in.
- Ch. 4 (Table 17, p.37) found heights from 21-49 in.

4.21 Shower Stalls

ATBCB RECOMMENDATIONS:

All provisions apply with the following additions:

4.21.3 Seat is supplemented by:
The seat provided in shower stalls used by children shall be mounted 15 in-17 in (380 mm-430 mm) from the bathroom floor and shall extend the full depth of the stall.

4.21.5 Controls is supplemented by:
Faucets and other controls in shower stalls used by children complying with 4.27.4 shall belocated as shown in modified Figure 37.

SUMMARY OF FINDINGS & REFERENCES:

4.21.3 Shower Stall Seat
UFAS (17-19 in) is too high. Evidence suggests that ATBCB (15-17 in) is more appropriate.

- Ch. 1 (Florida 8.7.3, p.106) stipulates 12-15 in.
- Ch. 1 (N.C., p. 106) 15-17 in
- Ch. 3 (Table 17, People's Housing, p.20) suggests 15-17 in.
- Ch. 4 (Table 17, GAB, MHS, p.37) observed 16 in.

4.21.5 Shower Stall controls
UFAS 38-48 in is high; 36 in conforms to children's reach ranges.

- Ch. 1 (Florida 8.7.5, p. 107) stipulates 36 in.
- Ch. 1 (N.C., p. 107) stipulates 36 in
- Ch. 3 (Table 17, People's Housing, p.20) suggests 28-36 in.
- Ch. 4 (p.101) suggests 36 in high.

4.22 Toilet Rooms

ATBCB RECOMMENDATIONS:

All provisions apply with the following addition:

4.22.1 **Minimum Number is supplemented by:**
In toilet rooms to be used by children, the supplementary recommendations in this document for 4.13, 4.16, 4.17, 4.18, 4.19, and 4.27 shall be applied where those sections are referenced in 4.22.

4.23 Bathrooms, Bathing Facilities, and Shower Rooms

ATBCB RECOMMENDATIONS:

All provisions apply with the following addition:

4.23.1 **Minimum Number is supplemented by:**
In bathrooms, bathing facilities, and shower rooms to be used by children, the supplementary recommendations in this document for 4.13, 4.16, 4.17, 4.18, 4.19, 4.21, and 4.27 shall be applied where those sections are referenced in 4.23.

4.24 Sinks

ATBCB RECOMMENDATIONS:

All provisions apply with the following additions:

4.24.2 **Height is supplemented by:** Sinks used by children shall be mounted with the counter or rim no higher than 30 in (760 mm) from the floor.

4.24.3 **Knee Clearance is supplemented by:** Knee clearance that is a minimum of 24 in (610 mm) high, 28 in (710 mm) wide, and 17 in (430 mm) deep shall be provided underneath sinks used by children.

SUMMARY OF FINDINGS & REFERENCES:

4.24.2 **Sink Height** UFAS allows 34 in height; data supports ATBCB (30 in).

- Ch. 1 (Florida 8.5.2.2, p.100) supports ATBCB 30 in.
- Ch. 3 (Table 17, NYS, p.20) supports UFAS 34 in.
- Ch. 3 (Table 17, Nellist, p.20) suggests 27-33 in.
- Ch. 4 (p. 23) notes the different requirements of children of different ages and disabilities; makes no recommendations.

4.24.3 **Sink Knee Clearance** Data is scarce and inconclusive. UFAS stipulates 27 in H x 30 in W x 19 in D.

- Ch. 3 (Table 17, People's Housing, p.20) suggests 25 in H x 28 in W x 17 in D.
- Ch. 3 (Table 17, NYS, p.20) suggests 30 in high and UFAS depth at 19 in.
- Ch. 4 (p. 22) urges adjustable shelving & storage.

4.25 Storage

ATBCB RECOMMENDATIONS:

All provisions apply with the following addition:

4.25.3 **Height is supplemented by:** Accessible shelves and hooks in storage spaces used by children shall be a maximum of 36 in (915 mm) above the floor. (See modified Fig. 38.)

SUMMARY OF FINDINGS & REFERENCES:

4.25.3 **Storage Height** UFAS max 54 in is "clearly too high for children" (Task 3 MHS, p. 10). Adjustable storage is ideal where possible. 36 in conforms to children's reach.

- Ch. 1 (Florida 6.5.3, p.85) stipulates 36 in max/wheelchair, and 46 in max for ambulatory children.
- Ch. 1 (N.C., p.87) stipulates 36 in high.
- Ch. 4 (p.97): found 54 in to be too high; 31 in was found to be too high for younger children.

4.27 Controls and Operating Mechanisms

ATBCB RECOMMENDATIONS:

All provisions apply with the following addition:

4.27.3 **Height is supplemented by:** The highest operable part of all controls, dispensers, receptacles, and other operable equipment used by children shall be placed no higher than 36 in (915 mm) and no lower than 20 in (510 mm) above the finished floor.

SUMMARY OF FINDINGS & REFERENCES:

4.27.3 **Control Height** Based on children's reach capabilities, 36 in appears to be an appropriate measure.

- Ch. 1 (Table 19, p.120) two states stipulate 36 in; two others stipulate 40 in.
- Ch. 3 (Table 19, Maryland, p.22) suggests max height of 48 in.
- Ch. 4 (p.21-23) observed 38 in to be too high.

4.27.4 **Control Operation** As with 4.13.11, Door Opening Force, 3 lbf is suggested max force.

- In the task 3 POEs, children were repeatedly observed having difficulty with operating mechanisms because of reach requirements and the force required to open the door. Force of 3 lbf max suggested.

4.30 Signage

ATBCB RECOMMENDATIONS:

All provisions apply with the following addition:

4.30.6 **Mounting Height is supplemented by:** Signs for use by children shall be mounted at a height no higher than 40 in (1015 mm) above the floor.

SUMMARY OF FINDINGS & REFERENCES:

4.30.6 **Signage Mounting Location and Height** Consensus agrees UFAS 54-66 in is high; ATBCB figure (40 in) seems right.

- Ch. 1 (Table 9, p. 60) Florida stipulates 42 in.
- Ch. 1 (Table 9, p. 60) N.C. stipulates 40 in.
- Ch. 3 (Table 9, Moore, p.12) suggests 40-42 in.
- Ch. 4 (p.14) observed signage approximately at eye level. For young children and teenagers using wheelchairs, 37 in appeared to be an appropriate height.

4.31 Telephones

ATBCB RECOMMENDATIONS:

All provisions apply with the following:

4.31.3 **Mounting Height is supplemented by:**
If intended for use by children, the highest operable part of the telephone shall be 36 in (915 mm) above the finished floor. Telephones used by children shall be installed in accordance with modified Fig. 44.

SUMMARY OF FINDINGS & REFERENCES:

4.31.3 **Mounting Height (Telephones)**
Phones should be within ATBCB (36 in) reach ranges.

- Ch. 1 (Florida 9.4.3, p.130) stipulates max height of 36 in for top of phone.
- Ch. 1 (Calif, p. 130) stipulates 44 in
- Ch. 1 (Texas p.130) suggests higher, 42-48 in.
- Ch. 3 (Table 21, People's Housing, p.24) suggests 36 in max.

4.32 Seating, Tables, and Work Surfaces

ATBCB RECOMMENDATIONS:

All provisions apply with the following additions:

4.32.2 **Seating is supplemented by:**
Chairs for children shall be 15 in to 17 in (380 mm to 430 mm) high with backs and arms.

4.32.3 **Knee Clearances is supplemented by:**
If seating for children in wheelchairs is provided at tables, counters, and work surfaces, knee spaces at least 24 in (610 mm) high, 30 in (760 mm) wide, and 19 in (485 mm) deep shall be provided.

4.32.4 **Height of Work Surfaces is supplemented by:**
The tops of tables and work surfaces used by children shall be a maximum 30 in (760 mm) from the floor or ground.

SUMMARY OF FINDINGS & REFERENCES:

4.32.2 **Seating**
UFAS makes no height stipulations; ATBCB recommends 15-17 in high, which follows findings for 4.16.3, toilet seat height.

- Ch. 1 (Florida 5.5.2, p.83) does not specify height but does suggest clear floor space of 30x55 in.

4.32.3 **Knee Clearances**
Scant data supports ATBCB figures, only a little wider.

- Ch. 1 (Florida 6.4.1#4d, p.83-4) knee space should be 36 in wide and 19 in deep.
- Ch. 1 (N.C., p.84) sets knee clearance height at 24 in.

4.32.4 Height of Work Surfaces
ATBCB 30 in recommendation is supported. Adjustable work surfaces strongly recommended, especially by Florida

- Ch. 1 (Florida 5.3.4, p.83) requires work surface height 30 in.
- Ch. 1 (Florida 6.4.1.3,4, p.83) sets height at 25-30 in depending on type of disability. Classrooms of different age groups should have counters of different heights. At least one 36 in wide section should be adjustable (25-30 in) or fixed at 30 in.
- Ch. 1 (N.C., p.84) stipulates 30 in high.
- Ch. 4 (p.16) observed work surface heights between 17 and 37 in AFF. Most common were 23-25 in AFF.

5. Restaurants and Cafeterias

ATBCB RECOMMENDATIONS:

All provisions apply with the following additions:

5.1 **General is supplemented by:**
In addition to the requirements of UFAS 4.1 to 4.33, the design of at least 5% of all fixed seating or tables in a cafeteria used by children shall comply with 4.32 as supplemented by these recommendations and the recommendations listed below. Access aisles between tables shall comply with 4.3. Where practical, accessible tables should be distributed throughout the space or facility. Accessible toilet rooms should be provided near the cafeteria and shall comply with UFAS 4.22 or 4.23 and the recommendations for water closets, urinals, lavatories and mirrors, shower stalls and sinks listed in this document.

5.2 **Food Service Lines is supplemented by:**
Tray slides used by children shall be mounted no higher than 30 in (760 mm) above the floor. The maximum forward/side reach by children for food service is 12 in (305 mm). If self-service shelves are provided, a reasonable portion must be within the ranges shown in modified Fig. 53.

5.3 **Tableware Areas is supplemented by:**
Install tableware, dishware, condiment, food and beverage display shelves, and dispensing devices used by children in compliance with 4.2, as supplemented by these recommendations (see modified Figure 54).

5.4 **Vending Machines is supplemented by:**
Install vending machines used by children in compliance with 4.27, as supplemented by these recommendations.

5.2

SUMMARY OF FINDINGS & REFERENCES:

5.2 Food Service Lines
UFAS allows 34 in tray slides; this is above children's reach. Findings support ATBCB (30 in).

- Ch. 1 (Florida 5.3.1, p.135) stipulates 30 in.

5.3 Tableware Areas
Tableware areas should be set according to children's reach abilities.

- Ch. 3 (Table 22, People's Housing, p.25) suggests max 30 in high.

UFAS 8. Libraries

ATBCB RECOMMENDATIONS:

All provisions apply with the following addition:

8.4 Card Catalogs is supplemented by:
Minimum clear aisle space at card catalogs, magazine displays, dictionary stands, or reference stacks to be used by children shall comply with modified Fig. 55. Maximum reach height shall be 36 in (915 mm).

SUMMARY OF FINDINGS & REFERENCES

8.3 Check-Out Areas
UFAS 4.32.4 allows 28-34 in high for work surfaces.

- Ch. 1 (Florida 5.2.4, p.77) stipulates 30 in max.
- Ch. 3 (Table 13, People's Housing, p.16) suggests 30 in max height.

8.4 Card Catalogues
UFAS (48 in) is too high for children's reach. Evidence supports ATBCB (36 in).

- Ch. 1 (Florida 5.2.5.2, p.77) stipulates 36 in.
- Ch. 1 (N.C., p. 78) stipulates 36 in.
- Ch. 3 (Table 13, People's Housing, p.16): 36
- However, Ch. 4 (p.15) observed "no problems" with catalogues up to 66.5 in tall.

8.5 Stacks
UFAS allows "unrestricted height" for bookstacks. This is fine when children have assistance, but 36 in reach ranges should be considered for unescorted children.

- Ch. 1 (Florida 5.2.6, p.78) stipulates min aisle width of 36 in, which conforms to UFAS 4.3.
- Ch. 3 (Table 13, People's Housing, p.16) suggests 36 in AFF.

- Ch. 4 (p.15) reported "no problems" with stacks (but they were measured only at GAB where the population was multiply disabled).

Appendix B

SUPPLEMENTARY COMMENTS AND RECOMMENDATIONS

The following recommendations include accessibility issues not covered by UFAS:

Accessible Route: General
There was general concern expressed by the Advisory Committee, reinforced by staff comments during at the POE sites, that an accessible route was often not available from the main school building to other facilities and spaces on the school campus. Lack of access to playgrounds and sports facilities were examples mentioned. Other examples include:

An accessible route from locker room to toilets, gymnasia and athletic fields.

An accessible route to art rooms, computer rooms, band and choral practice areas, stages, school store, etc.Provide an accessible route from locker to toilets, gymnasiums and athletic fields. In addition to the requirements in UFAS 4.1 to 4.33, as supplemented by these recommendations. Accessible locker rooms and gymnasium lockers used by children should have the following:

Height and Clearances: Accessible Lockers
Accessible lockers used by children shall have a minimum width of 15 in (381 mm) or be twice the width of a standard locker. Locker shelves and hooks should be a maximum height of 36 to 42 in (914 to 1067 mm) above the floor. There must be one shelf at least 30 in (762 mm) above the floor.

Appendix C

THE CONSENSUS PROCESS

Step 1: Appointment of the project Advisory Committee. This was carried out at the beginning of the project. However, there were several changes during the course 0f the project. Two members had to resign because of other commitments. Highly qualified replacements were found. Also, we were fortunate in having a number of colleagues in North Carolina available to join the Committee. Two of these professionals had been instrumental in facilitating three of the POE's in the Raleigh area. See Appendix C for the final listing of the Advisory Committee.

Step 2: Pre-meeting review of the Draft Recommendations (Task Report 4) and the back-up documents (Task Reports 1 - 3). The review documents were mailed out more than two weeks ahead of the Consensus Meeting to allow sufficient time for review by committee members.

Step 3: Two-day consensus meeting. This was held over a two-day period in Raleigh, North Carolina. In order to maximize the expertize of the members, the full committee was subdivided into three working groups, each of whom reviewed different UFAS sections of the Draft Recommendations (Task 4) document. Each of the working groups presented their consensus recommendations on each section to the full committee for final approval. By the end of Day Two of the meeting, all of the draft recommendations had been reviewed in this manner.

Members of the research team acted as chairs of the working groups and presented the consunsus reports to the full committee plenary sessions.

Appendix C lists two concerns that the Advisory Committee wanted to highlight. The first, relating to accessible routes is actually covered by the existing UFAS standard. However, it appears to be a major issue on school sites and deserves further investigation. The second, relating to lockers, was felt by the committee to be important enough to highlight for special emphasis.

Step 4: Final review of selected portions of the Draft Task Report 5. Most of the Advisory Committee agreed to review selected portions of this current document to ensure that it is an accurate record of the consensus decisions made at the meeting.

Appendix D

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RESOURCES

ANNOTATED BIBLIOGRAPHY OF SELECTED REFERENCES

Abend, A.C. (1979). Design criteria for educational facilities for special education services, *Journal of Research and Development in Education, 12* (4), 23-35, November 4.

Recognizing that the ANSI Standard was based primarily on research done with adults with physical disabilities and that other age groups must be represented in the design of a building, the Maryland Board of Education undertook post occupancy evaluations of 19 schools in order to develop design criteria as a guide for renovating existing school facilities and for the construction of new facilities in the State. Schools selected for the study were those that that had been designed or redesigned for special education; were not more than five years old, had at least 50 handicapped students, and were distributed across the U.S. The evaluations included observed use of space and interviews with administrators, teachers, aids and students. Results of the evaluations were compiled into building design criteria including space and spatial relationships, furniture design and layout, surfaces and types of programs and program spaces.

Adaptive Environments Center (1980). *Environments for All Children*, Access Information Bulletin, National Center for a Barrier Free Envrionment: Washington, D.C.

This bulletin summarized some of the issues that are critical in the design of environments that include all children, regardless of their disabilities. The issues cited do not comprise a formula for designing for disabled children; they are guidelines for good design. Several principles are recommended: scale; well defined activity areas; transition spaces; storage; flexibility; multi-sensory cues; variety of social settings; personalized spaces; safety and challenge; independence and supervision; and responsive elements.

Bails, J.H. and B.R. Seeger (1990). *Ergonomic Design for Physically Disabled Children, Parts1 and 2*, Kilkenny, Austrailia: Regency Park Center.

This research was undertaken to address difficulties in designing accessible school buildings. The study included 288 children aged 3 to 18 years. The sample included 179 children with disabilities including: 61 ambulant disabled children without mobility aids and 25 with crutches or walkers, 48 children in manual wheelchairs and 43 in power chairs. The sample also included 109 children without disabilities. Each subject was tested at 30 stations, where 72 variables were measured relating to mobility, reach, strength and size. were tested in order to develop design guidelines. The variables tested included ability to traverse ramps; curb ramps and steps; reach over desks and to fixtures on walls: transfer to, or use seats, toilet pans and basins; position wheelchairs and limbs under benches, sinks and tables; read objects on shelves; turn levers, knobs, and tap handles; and open doors fitted with closers (see Section 2. Comparative Tables for Ergonomic Data). Based on the data from the study, a set of 21 design guidelines were developed. In accordance with the Australian Standard 1428 Design Rules for Access by the Disabled, the guidelines were developed to respond to the abilities of eighty percent of the children in the study sample.

Honig, B. (1987). *Program Guidelines for Visually Impaired Individuals*, California State Department of Education: Sacramento.

Although no architectural specifications are provided, guidelines for class or resource rooms for visually impaired students in special programs are given. In general, classrooms should be the standard size for regular classrooms, and should include: 1) appropriate lighting meeting minimum standards, including lighting which is adjustable to meet varying needs of low vision students; 2) adequate storage space for special equipment; 3) A separate area for listening activities; 4) furniture and chalkboards (black or green) with nonglare surfaces; and 5) a sufficient number of electrical outlets for specialized equipment.

Honig, B. (1986). *Program Guidelines for Hearing-Impaired Individuals*, California State Department of Education: Sacramento.

Educational environments used by children with hearing disabilities should be sufficiently flexible to accommodate children's needs as well as new developments in the provision of instruction to these children. In addition, special attention should be given to 1) color that will provide contrasting background for ease in lip-reading and reading sign language, 2) acoustics that control and reduce of ambient noise and intrusive sound (eg. fluorescent light ballasts, mechanical equipment, outside noise, etc.) and permit the best use of audiological devices (e.g. through carpeting and acoustical tile), 3) adequate, non-glare lighting, 4)emergency warning and signalling devices such as strobe lights or other electrical devices, and 5) multi-media teaching equipment such as tape recorders or turntables that can be connected with a group hearing aid, film and slide projectors, and television receivers with caption decoders.

Honig, B. (1986). *Program Guidelines for Individuals who are Deaf-Blind*, California State Department of Education: Sacramento.

The physical environment for students who are deaf-blind should be safe, provide motivation for movement and exploration, and encourage maximum use of residual senses. The classroom should have: 1) adjustable, non-glare lighting that can be changed to accommodate individual needs; 2) contrasting color to facilitate orientation and visual attention; 3) colored tape and covered rope floor markings to aid in classroom mobility; 4) landmarks outdoors to identify drop-offs (e.g., curbs), gradients, and other unusual environmental obstacles; 5) alternative signalling devices to alert students to emergencies; 6) carpeting and acoustical tile to permit the best use of audiological devices; and 7) a mechanism to control ambient noise. In addition, a tactile/sensory area is beneficial to the young child. This area could include tactile tunnels, textures mounted on walls, crawl spaces, etc. A sound-proofed room may be used as a darkroom for visual and auditory training. The facility should also provide a variety of tactile, auditory, motor, and visual materials and equipment. These include: auditory trainers, beep balls, closed circuit television with closed captioning, computer with speech synthesizer, illumination devices, large-print materials, optacon, braille printer, talking calculator, TDD, etc.

Honig, B. (1986). *Program Guidelines for Severely Orthopedically Impaired Individuals*, California State Department of Education: Sacramento.

These guidelines cover the construction of facilities that provide comprehensive programs for pupils with severe orthopedic problems. Although no design qualitative specifications are given, the guidelines restrict the location of such facilities, dictating that they should not be constructed on isolated sites or away from the main facilities on existing sites. The guidelines further recommend that facilities for these pupils should provide: 1) additional square footage in classrooms to accommodate the many pieces of specialized equipment; 2) adequate storage for the wide variety of required classroom supplies and equipment; 3) easy, wheelchair access to bathrooms from the classrooms; 4) vertical and horizontal grab bars for transferring in toilet areas; 5) health room where an ill pupil can be isolated from other pupils and storage for specialized equipment such as oxygen; 6) a training kitchen to develop independence in activities of daily living adjacent to the classroom; 7) a speech room; 8) a conference room for children and adults; 9) space for the California Children Services that will house the physical and occupational therapy units as well as an area for an orthopedist and pediatrician, 10) adapted outdoor play equipment; and 11) a loading/unloading zone that has accommodations for wheelchairs and provides protection from the weather.

Honig, B. (1986). *Program Guidelines for Language, Speech and Hearing Specialists Providing Designated Instruction and Services*, California State Department of Education: Sacramento.

An instructional area should be provided that allows adequate space for both individual or group therapy. The room should be located away from sources of distracting noises such as the cafeteria, auditorium, bathroom, etc. Good lighting, adequate ventilation, several electrical outlets, and a chalkboard are essential.

Levine, M. and Nimowitz, S. (1976). *A Playground for All Children: Book 1 - Site Selection: Book II.- Design competition program; Book 3 - Resource Book*, New York City Department of City Planning, U.S. Dept. of Housing and Urban Development, U. S. Government Printing Office: Washington, D.C.

The three booklets describe the development of the nation's first outdoor public playground designed for integrated play by handicapped and non-handicapped children. The first booklet describes the special play needs of the children, ages three to eleven and the special features that are necessary for this group of children. These include: 1) spaces and equipment that are accessible to and able to accommodate children using mobility aids and those with arthritis; 2) handrails for different age groups, 3) special back and arm rests (or benches without backs so children could use them in various ways); 4) a safe environment; natural and artificial (e.g. roof structure) 5) shading; 6) extra drinking fountains and toilet rooms in close proximity; 7) special toilet facilities with higher seats and grab bars; 8) special textures, braille signs, and waist-high fencing/guard rails for blind children, and 9) resilient surfaces that allow safe wheelchair mobility and movement of children with crutches. The second book covers the design competition, devised by the City of New York, including an appendix of accessibility design criteria (see Tables). The third booklet documents the development of the playground in terms of both process and product. Also documented in this volume is a description of site visits to 39 play facilities around the world.

Lewis, B. (1985). The stigmatized house, in S. Klein, R. Wener and S. Lehman (Eds.), *Environmental Change, Social Change, The Proceedings of the Sixteenth Annual Conference of the Environmental Design Research Association*, June 10-13, Omnipress; Madison, WI.

There comes a time when severe mobility problems necessitate the removal of architectural barriers in the home. This is often done in the face of emotional as well as practical obstacles to removing the barriers. This paper is based on interview with parents and six children with severe mobility problems. Data was collected from environmental biographies, residential

histories, and drawings of ideal homes completed by both parents and children. The paper concludes that people are reluctant to alter the external appearance of their home in ways that will call attention to themselves as being significantly different from others.

Maryland State Department of Education (Abend, A.C., Bednar, M.J., Froehlinger, V.J., and Stenzler, Y). (1979). *Facilities for Special Education Services: A Guide for Planning New and Renovated Schools*, Maryland State Department of Education, Council for Exceptional Children: Reston, VA.

The purpose of this study was to produce performance based design criteria and guidelines that not only addressed typical barrier free design variables, but also other relevant architectural design elements such as space, spatial relationships, acoustics, lighting, climate, furniture, equipment, equipment storage and display. The primary method for developing these criteria was the evaluation of 19 existing special educational facilities. The post occupancy evaluations were designed to: 1) gather information on the functional and architectural character of the facilities; 2) determine the degree to which these functional characteristics support the activities taking place; 3) conduct interviews with teachers, aids, students and administrators using the facilities; and 4) analyze the educational spaces. Although this study primarily resulted in the development of space standards, accessibility design criteria (see Section 1. Comparative Tables for Design Specifications) were also developed.

Melvin, J. H. (1980). *Play spaces to accommodate disabled children*, Central Mortgage Housing Corporation: Ottawa.

Based on the impact of design on child development, this report presents guidelines for the design of integrated playground facilities for both handicapped (primarily non- and semi-ambulatory) and non-handicapped children. The guidelines include site selection (size. microclimate, topography, access, etc.) site planning (function and organization, surfacing, circulation, walks, slopes, ramps, handrails, washrooms, entrance, etc.) and types of play (sliding, climbing, swinging, etc.). The Lord Roberts Elementary School was presented as a case study to illustrate how playground facilities can be adapted to include the combined play of all children.

Moore, G.T., Cohen, U., Oertel, J. and van Ryzin, L. (1979). *Designing Environments for Handicapped Children: A Design Guide and Case Study*, Educational Facilities Laboratories: New York.

This publication summarizes the findings and design ideas from applied research, programming, and a design project for disabled children. Results from the research are presented in terms of 14, behaviorally-based, developmental goals (e.g., gross motor development, fine-motor development, spatial awareness, language, social interaction, etc.) from which 14 design principals intended to enhance these goals were derived. Of the 14 design principles, only the final one, *barrier-free environment*, includes actual design specifications for ramps, stairs, doors, pathways, etc.(see Section 2. Comparative Tables for Design Specifications). The purpose of this design guide is twofold. First the design principals are the basis from which specific architectural programs for both indoor and outdoor facilities for handicapped children can be derived, and second, the case study illustrates the application of the design guide to a particular site. One shortcoming of the design guide is that it does not include children with orthopedic impairments unless they are one of several multi-disabling conditions.

This text is out of print. It has been reprinted in Cohen, U., Hill, A.B., Lane, C.G., McGinty, T. and Moore, G.T. (1989). *Recommendations for child play areas*, Milwaukee, WI: University of Wisconson Milwaukee.

Moore, R. , Goltsman, S. and Iacofano, D. (1987). *The Play for All Guidelines: Planning, Design, and Management of Outdoor Play Settings for All Children*, MIG Communications: Berkeley CA.

This text provides the most comprehensive design guide for play environments including information on planning criteria, play value, programming potential, safety, risk management, accessibility, integration, and management and maintenance. Like most of the other guidelines for play spaces, the guidelines are primarily conceptual, approaching design from a developmental rather than ergonomic/anthropometric perspective. Two concepts, 1) exterior pathways and 2) signage, however, are particularly relevant to accessibility specifications(see Section 2. Comparative Tables for Design Specifications). Pathways provide accessibility and separate functionally different spaces; they enable users to move between and through elements and help them to orient in space. Specific design information is provided for safe and easily accessible pathways. Pathways require good surfaces and correct gradients. A hierarchy of path difficulties including accessible, usable, and difficult, can be provided. Signs that can communicate to people of all abilities are vital. They insure good orientation, direct traffic flow and provide general information. There is a need to emphasize graphic signs, especially those that are child-oriented. International characters and standards should be used as much as -possible. Appropriate heights, depth, colors, pictographs and tactile qualities can be used to communicate information.

Nellist, I. (1970). *Planning Buildings for Handicapped Children*, Charles C. Thomas: Springfield, IL.

The primary focus of this text is on the need for design requirements for schools and group homes not only to meet the needs of mentally handicapped children, but also to enable staff to exercise control. Specifications for a number of design issues are cited (see Section 2. Comparative Tables for Design Specifications). These include: heating, plumbing (showers, toilets, laundry facilities, and controls), lighting, ventilation, and finishes. A minor focus of the text (one chapter) is devoted to physically handicapped children. Design specifications are limited to doors and thresholds, toilets, baths, classrooms and dining areas.

New York State (1981). *Making School Programs Accessible to the Handicapped: a Guideline for New York State School Districts*, State Education Dept., Office for Education of Children with Handicapping Conditions: Albany, N.Y.

School program accessibility is composed of three components - the school, the school program, and program accessibility. The school, which encompasses the physical building, its internal and external architecture, landscaping, roadways and other facilities used in conjunction with the school program will be focused for purposes of this review. Standards and specifications were compiled from information published by the American Foundation for the Blind and ANSI 1980. Certain elements were selected as being most critical for educational facilities and most pertain to interior spaces (see Section 2. Comparative Tables for Design Specifications). These include: doors, ground and floor surfaces, lighting, stairs, elevators, emergency exits, bathrooms, telephones, drinking fountains, signs, alarms, tactile warnings, curb ramps and ramps. Although exterior elements are not included, it is acknowledged that street crossings, islands, outdoor furnishings, plantings and obstacles should be taken into consideration when planning and developing the outdoor environment.

People's Housing Inc. (1985). *Accessibility Design Guidelines for Public Facilities Serving Children*, People's Center for Housing Change: Topanga, CA.

The design guidelines presented in this report are based on empirical research conducted by Steinfeld and Czaja (1980) related to the anthropometrics of handicapped children. Fifty-one handicapped children (15 in wheelchairs and 36 ambulant and semi-ambulatory) participated in the study. Areas of study included: static and dynamic anthropometric data, push-pull strength, controls and dispensers (such as faucets, door knobs and toilet paper dispensers), lavatory heights, stair dimensions, ramp specifications, door maneuvering and corridor clearances (see Section 2. Comparative Tables for Design Specifications). The data was used to develop guidelines for passenger loading zones, walks and corridors, hazardous objects and areas, accessible entries, life safety provisions, stairs and ramps, platform lifts, auditoriums, cafeterias, classrooms, meeting rooms, libraries, gymnasiums, toilet rooms, doors and doorways, corridor handrails, sinks, drinking fountains, warning signals, signage, and telephones. None of the anthropometric data upon which the guidelines are based is included in the report.

People's Housing, Inc. (1981). *Accessible Elementary Schools: A Renovation Planning and Design Manual*, Topanga: CA, March.

Based on the ergonomic research conducted by Steinfeld (1979) this manual developed potential solutions to accessibility problems that were typically found in elementary schools.

Schneekloth, L. (1980). *Environments for Visually Impaired Children: Design Guidelines*, unpublished ms, College of Architecture, Virginia Polytechnic Institute and State University: Blacksburg, VA.

Through consultation with educators and a review of relevant literature, design ideas or patterns were developed to evaluate existing play areas and to guide the design of new ones. The patterns devised contain information about design ideas that state hypotheses about a physical object or situation and the potential relationship with a visually impaired child. The intent is that the appropriate patterns could be chosen according the situation and that they would be used as a mechanism for making design decisions. Although most of the design patterns focus on stimulating the child in order to enrich the play experience, several principles such scale, danger coding, landmarks, multiple coding, and safety are also included.

Schneekloth, L.H. (1989). *Play Environments for Visually Impaired Children*, Journal of Visual Impairment & Blindness, 83(4), 196-201 (April).

The motor activities and environmental interactions of sighted and visually impaired children were compared during unstructured play. The comparison was intended to: 1) assess motor proficiency level; 2) establish frequency and kind of gross motor, manipulative, self-stimulation, and social/play behaviors; and 3) assess their use of the environment. The results suggest that some visually impaired children have some developmental delays; and these can be attributed to a lack of opportunity for gross motor interactions with the environment. Design concepts based on principles of child development are proposed for

the design of play environments. These include: real world things, miniaturization, large soft areas, and complexity

Steinfeld, E. and Czaja, S.(1980). *Human Factors Research with Disabled Children*, Peoples Center for Housing Change: Amherst, NY

Fifty-one (31 disabled and 20 able-bodied) children ranging in age from 5 to 13 years, from the Buffalo, NY public schools participated in this ergonomic study. The study evaluated both selected functional capabilities of the children and a number of design requirements necessary to accommodate their capabilities (see Section 3. Comparative Tables for Ergonomic Data). Functional capabilities included travel rate and distance, push/pull strength, and grasping reach. Design recommendations covered optimal grab bar dimensions, handrail height, sink and toilet heights, stair dimensions and ramp slope, and the height of paper dispensers, door knobs and faucet handles. The research findings produced design specifications for mounting heights, clearances, grasping dimensions, etc.

Torrice, A.F. and Logrippo, R. (1989). *In My Room: Designing For and With Children*, Fawcett Columbine: New York.

One of the few texts written from the designers', rather than researchers' or rehabilitation professionals' perspective, the authors' maintain that no matter what the mental or physical capabilities of children, they all need to personalize their own space. Efforts to individualize a disabled child's room should foster a greater sense of control by promoting personal choice, personal color and convertability. Although the authors do not offer quantitative solutions to architectural barriers, they do note that height, reach, and strength are critical ergonomic factors. As a consequence they maintain that there is no place where height (ie. outlets, switches, shelves), width (ie. doorways), and depth (ie. cabinets, furniture) measurements are more important than in the room of a disabled child. Finally, design guidelines for a furniture system that is modular, easily stacked and rearranged are offered. These include: 1) the use of castors on all furniture to allow total mobility without dismantling components; 2) drawer glides to permit easy use, especially someone with diminished hand strength; 3) slide out writing surfaces to enable children in wheelchairs to pull a work area over their laps; 4) stackability to enable numerous height possibilities as the activity requires.

Wilkinson, P.F. (1982). Providing integrated play environments for disabled children: a design or attitude problem?, in P. Bart, A. Chen and G. Francescato (Eds.), *Knowledge for Design, Proceedings of the Thirteenth Annual Environmental Design Research Association Conference*, EDRA, Inc.: Washington, D.C.

Research has shown that most municipalities and special service agencies do not provide adequate play opportunities for disabled children living in the community. This research presents the results of a study of 65 service agencies in Ontario, Canada. The general conclusion is that staff in agencies who were involved in integrated play programs considered the attitudes of parents and recreation personnel to be the major barrier to integrated play environments. Staff not involved in such programs, on the other hand, blamed cost, safety, lack of responsibility, staff shortages and education as the major barriers.

World Rehabilitation Institute (1985) *The More We Do Together: Adapting the Environment for Children with Disabilities*, World Rehabilitation Fund, Inc.: New York City.

Translated into English by the World Rehabilitation Institute, this text describes different types of aids and devices available for disabled children. The aids listed can be used in a range of environments including schools, bedrooms, baths and kitchens. The text also include a list of foreign and domestic aids that are available.

Yuker, H.E. (1968). *The Modification of Educational Equipment and Curriculum for Maximum Utilization by Physically Disabled Persons*, Albertson: New York.

This document describes the design guidelines that were developed for a school for 200 disabled and non-disabled children. The guidelines are limited in their architectural specifications, and where specifications are given, they are sometimes more lenient than ANSI (1980). All areas of the school are covered by these guidelines, including classrooms, science lab, cafeteria, library, playgrounds and auditoria.

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